KING COUNTY CONVEYANCE SYSTEM IMPROVEMENT PROJECT

SHERIDAN BEACH RELIABILITY PROJECT ALTERNATIVE ANALYSIS REPORT

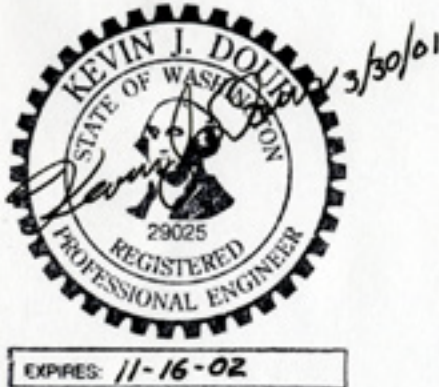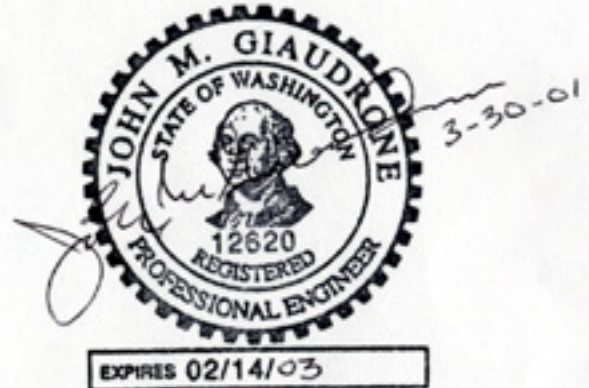# FINAL REPORT

MARCH 2001

KING COUNTY

CERTIFICATE OF ENGINEER

The technical material contained in this report was prepared under the supervision and direction of the undersigned, whose seals, as professional engineers licensed to practice as such are affixed below.

3/30/01

EXPIRES: 11-16-02

3-30-01

EXPIRES 02/14/03

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ACKNOWLEDGEMENTS

LIMITATIONS AND EXCEPTIONS

This report reflects the data and information relating to the Sherdian Beach study area provided to GSA at the time of the field investigations. Assumptions and analysis were conducted using information and flow criteria provided by King County, the City of Lake Forest Park, Ronald Wastewater District (a.k.a. Shoreline Wastewater Management District) and the City of Seattle. No warranty is expressly stated or implied in this report with regard to the condition of the collection system or flow values. This report reflects the results of our alternative analysis, using the criteria provided, and does not cover other conditions beyond the scope of this project that were not visible or evident during our field activities and analysis.

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SECTION 1: INTRODUCTION, BACKGROUND, AND PURPOSE

1.1 INTRODUCTION AND BACKGROUND

The Sheridan Beach collection system is located along the west shore of north Lake Washington. The area is located within the City of Lake Forest Park. The local wastewater collection system conveys wastewater to the King County Kenmore Interceptor Section 2, commonly referred to as the Kenmore Lake Line, at two connection points. These are an 8-inch connection located off of Shore Drive NE between NE 165th Street and NE 170th Street. The other connection is a 12 inch diameter pipe located off Shore Drive NE immediately south of the unused NE 160th Street right-of-way (Figure 1-1).

In the past, this area drained to several small pump stations located along the shore of Lake Washington. These pump stations conveyed the wastewater southwards towards a local treatment plant located near Matthews Beach Park. When Metro was formed, these small pump stations were taken out of service and the local collection systems were connected to the Kenmore Lake Line.

In 1990, the City of Seattle (City) constructed the Burke Gilman Trail Sewer Rehabilitation Project. In this project, the City made several improvements and modifications to the sewer that runs along the Burke Gilman Trail. In the Sheridan Beach area, the previously abandoned pump station was fully decommissioned, and three sewer crossings were made along the Burke Gilman Trail. The previously abandoned pump station was located at Shore Drive NE adjacent to the 8-inch connection to the Kenmore Lake Line. The installed sewer crossings were located at the Burke Gilman Trail and NE 165th Street, along the Burke Gilman Trail approximately 500 feet south of NE 165th Street, and along the Burke Gilman Trail immediately south of the unused NE 160th Street right-of-way. See Figure 1-1.

In the winter of 1996-97, Western Washington experienced record snowfalls. In late December into early January, several inches of snow accumulated in the Seattle area. As this snow melted, an unusual amount of surface runoff was experienced. Several residences along Shore Drive NE between the 8-inch connection and NE 160th Street experienced sewage backups and overflows. It is believed that the excessive quantities of runoff due to the snow melt resulted in extreme infiltration & inflow conditions that overloaded the wastewater collection system and resulted in the sewage backups.

In July 1999, Garry Struthers Associates, Inc. (GSA) was given the task through HDR Engineering, Inc. to conduct a preliminary evaluation of the wastewater collection system as part of King County's Wastewater Conveyance System Improvements Project. At that time GSA examined and evaluated a copy of the City's manhole map, the as-built drawings from the Burke Gilman

Sewer Rehabilitation Project, and King County GIS maps. No field visits were conducted at that time. GSA submitted a letter report to King County outlining recommended further investigation, a conclusion of the likely problems within the local collection system, and recommended solutions which were believed could correct the problem. Within this report are the results of the further investigation and verification recommended in that letter report from the initial investigation.

In April 2000, CHS Engineers, Inc. completed a study of the Sheridan Beach Collection System requested by the Ronald Wastewater District. Their study indicated the same general findings and reached similar conclusions about the condition of the system and the cause of the overflows.

1.2   PURPOSE OF THIS STUDY

The purpose of this study is to develop a recommended solution to increase the reliability of the Sheridan Beach Collection system such that the likelihood of future flooding events is greatly diminished or eliminated. This study involves further investigation and analysis of the collection system and develops recommended alternative solutions. Selection criteria are developed and an alternative analysis conducted to arrive at a recommended solution.
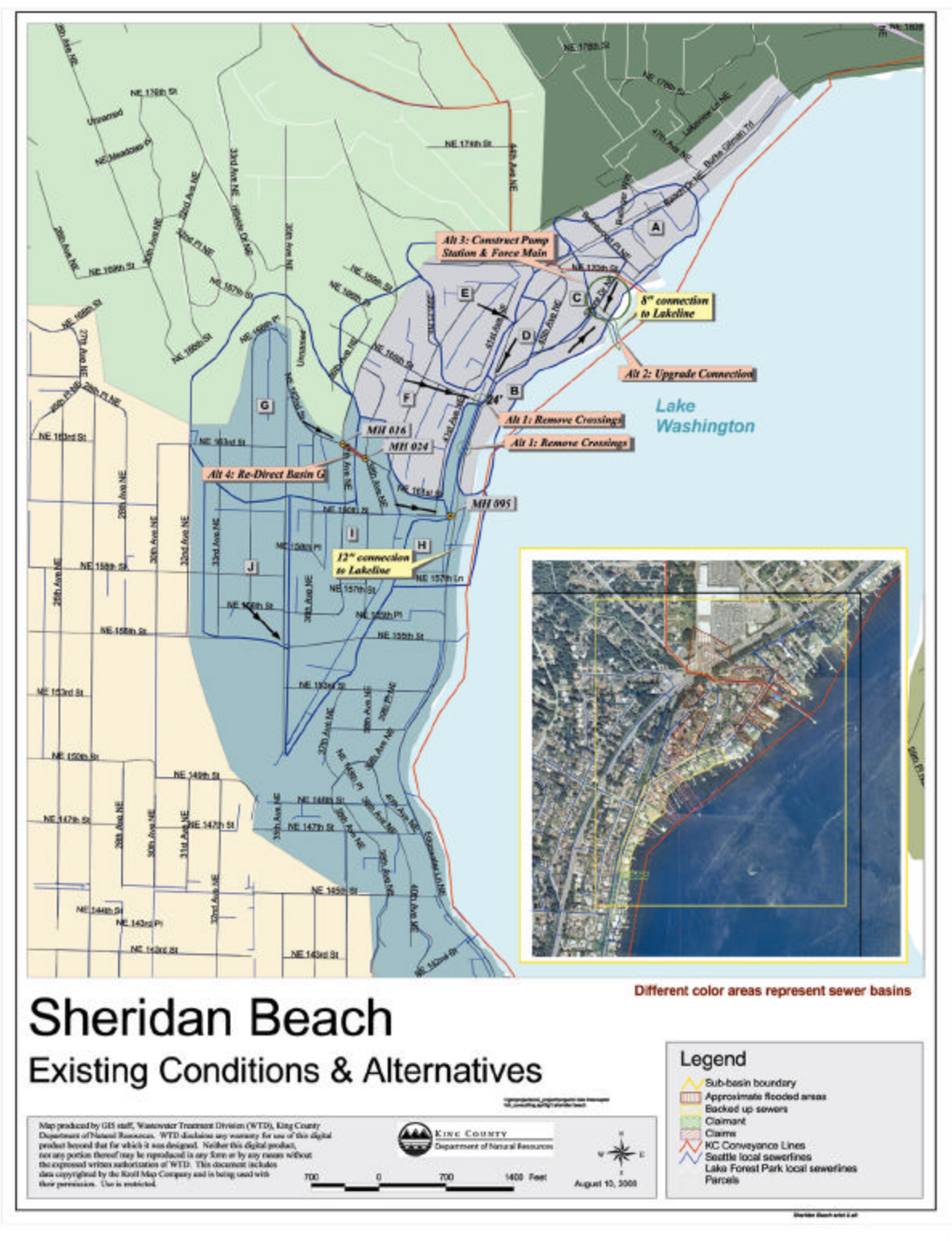
Figure 1-1: Existing Conditions & Alternatives

SECTION 2: INVESTIGATION AND FINDINGS

2.1 FIELD INVESTIGATION

GSA conducted field investigations to verify invert information and resolve questions regarding the system configuration. Key questions centered around the sewer running along the Burke Gilman Trail between NE 165th Street and NE 160th Street (Manhole 218 southward to Manhole 230 along the Trail). For manhole numbers, refer to the copy of the manhole map in Appendix A. City sewer maps and as-built drawings lacked invert information for many of the manholes along the Burke Gilman Trail within the study area. There were also questions regarding the direction of flow at some key manholes and how the system might behave during high flow events.

Invert elevations were measured in the field using a survey level. Manhole lids were lifted and measure-downs were taken. The field investigation did not include all manholes within the study area. Rather, only those manholes where there were questions regarding the direction of flow and/or invert data were investigated. As stated, this involved manholes along the Burke Gilman Trail between NE 165th Street and NE 160th Street.

For all manholes opened, the direction of flow and the condition of the channel were noted. Some manholes had very little flow and considerable solids collected in the channel. Changes made during the Burke Gilman Sewer Rehabilitation project were also noted and confirmed.

2.2 HYDRAULIC MODELING

Hydraulic modeling was conducted for a limited number of pipes within the study area. This was done to confirm existing system capacity and to determine the impact proposed changes would have on the system. This helps determine the viability and anticipated reliability of a proposed alternative.

Pipe capacities were calculated using the Mannings Equation as follows:

$$Q = (1.49/n) \, AR^{2/3} \, S^{1/2}$$

Where: Q = Flow in cubic feet per second (cfs)
                  n = Mannings friction coefficient (0.013)
                  A = Cross sectional area of flow
                  R = Hydraulic Radius (D/4)
                  S = Slope

The local collection system was analyzed assuming free-discharge into the Kenmore Lake Line.[1]

Estimated wastewater flows were calculated using planning criteria from King County, City of Lake Forest Park, Ronald Wastewater District, and City of Seattle.[2] The criteria used are as follows:

<u>King County:</u>　　　　　　　　3.2 people per parcel
　　　　　　　　　　　　　　　60 gallons per capita per day
　　　　　　　　　　　　　　　2,900 gallons per acre per day for Infiltration & Inflow (I&I)

　　　　　　　　　　　　　　　Calculated Peaking Factor:

Upstream Acreage	Peaking Factor
1,000	3.0
100 or less	4.0

<u>City of Lake Forest Park:</u>　　　2.4 people per parcel
　　　　　　　　　　　　　　　85 gallons per capita per day
　　　　　　　　　　　　　　　1,100 gallons per acre per day for I&I
　　　　　　　　　　　　　　　Peaking Factor: 3.0

<u>Ronald Wastewater District Criteria #1:</u>

　　　　　　　　　　　　　　　12 people per populated acre
　　　　　　　　　　　　　　　77% of a Basin's area is populated
　　　　　　　　　　　　　　　85 gallons per capita per day
　　　　　　　　　　　　　　　1,100 gallons per acre per day for I&I

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[1] Criteria provided by King County, Stakeholders' Meeting, 5/18/00.

[2] Criteria developed from Stakeholders' Meeting, 7/27/00.

Calculated Peaking Factor:

Upstream Acreage	Peaking Factor
1,000	3.0
100 or less	4.0

Ronald Wastewater District Criteria #2:

12 people per populated acre
77% of a Basin's area is populated
60 gallons per capita per day
2,500 gallons per acre per day for I&I
Calculated Peaking Factor:

Upstream Acreage	Peaking Factor
1,000	3.0
100 or less	4.0

City of Seattle: 2.5 people per parcel
60 gallons per capita per day
1,200 gallons per acre per day for I&I
Peaking Factor: 2.8

The service area contributing to the 8-inch and 12-inch Lake Line connections has been divided into 10 basins labeled Basin A through J (Figure 1-1). The calculated flow values generated from each basin using each of the above listed criteria are shown in the spreadsheets in Appendix B.

The results of the hydraulic modeling calculations for each of the alternatives are discussed in Section 3 of this report. The calculation spreadsheets are located in Appendix B. The hydraulic calculations for the existing condition indicate that the sewer along Shore Drive NE from NE 165th Street to the 8-inch Lake Line Connection is over capacity when the King County and either of the two Ronald Wastewater District flow generation criteria are used. The calculations indicate that the system is not over capacity when the City of Lake Forest Park and City of Seattle flow generation criteria are used. However, these calculation sheets indicate that there is only limited excess

capacity in the line from NE 165th Street to the 8-inch Lake Line Connection (in some segments less than 25-gpm excess capacity).

2.3   FINDINGS

Several key pieces of information and data were found during the field investigation. All the missing manhole elevations were measured and recorded. The inverts indicate that the sewer along the Burke Gilman Trail is relatively flat with an undulating profile. Although the sewer is currently undulating, previous to the Burke Gilman Sewer Rehabilitation Project the sewer probably had a slight slope southward. The City of Seattle confirmed that the Burke Gilman Sewer had carried the flow from the abandoned pump station and the basins coming down along NE 165th Street (Basins F & G in Figure 1-1). It is likely that the inverts at the manholes where crossing were installed are lower now than they were previous to the rehabilitation project.

Table 2-1 shows the manhole data collected along the Burke Gilman Trail. Rim elevations and measure-downs to the inverts of the channels were taken for the manholes. Rim shots were taken at manholes where the elevations were known from the City's manhole map and were used to provide reference to the City system. Measure downs for those manholes for which we already had data checked within approximately one-tenth of a foot (+/-).

Table 2-1
Summary of Manhole Data Along the Burke Gilman Trail

Manhole #	Rim Elevation (ft)	Invert (ft)	Distance Between Manholes (ft)
241	24.94	18.01	
218	*27.49*	*20.06*	*67*
234	25.50	20.30	331
239	*25.46*	*18.09*	*176*
233	25.90	20.07	164
232	28.14	20.39	401
095	25.76	20.26	123
236	25.22	19.73	160
237	*24.79*	*17.10*	*153*
248	24.48	18.17	139
249	24.92	19.29	67
230	28.13	19.83	195
113	27.11	20.00	287

Note: Data in Italics are manholes where crossings were installed during the Burke Gilman Rehabilitation Project.

There was little flow in the sewer along the Burke Gilman Trail between NE 165th Street and NE 160th Street. The City sewer cards show this sewer now serves only the homes uphill from the trail along the east side of 41st Avenue NE.

Sewage could be heard coming down the hill at Manhole 095 although there was little or no sewage flowing in the manhole's channel. Manhole 095 had a pipe entering from the south and exiting to the north. The sewage could be heard from the south pipe entrance. No manhole could be found at the intersection of the sewer along NE 160th Street and the Burke Gilman sewer. The City of Seattle confirmed that the sewer coming down the hill connects to the Burke Gilman sewer with a tee and not a manhole. Manhole 095 is immediately north of this tee (approximately 20 feet).

At NE 165th Street, there was steady flow coming down the hill, going through the crossing installed from the rehabilitation project, and heading northward along Shore Drive NE towards the 8-inch connection to the Kenmore Lake Line.

At the time of the field investigation, the crossing 500 feet south of NE 165th Street was not sending much flow towards the 8-inch connection. However, significant additional flow was being routed to the 8-inch connection from the basins upstream of the crossing installed at NE 165th Street. It was found that the invert of the tee at the intersection of the line coming down the hill along the unused NE 160th Street right-of-way with the Burke Gilman Sewer and the manhole immediately north along the Burke Gilman Trail (MH 095) are only 0.09 feet (approximately 1 inch) different in elevation. It is believed that under normal flow conditions most of the wastewater coming down the hill (from Basins I & J) heads southward towards the 12-inch connection. But during high flow conditions some of the wastewater backs up and flows northward through MH 095, through the crossing 500-feet south of NE 165th Street along the Burke Gilman Trail, and northward along Shore Drive NE to the 8-inch connection. This further aggravates the conditions along Shore Drive NE and at the 8-inch connection.

SECTION 3: ALTERNATIVES

This section presents the alternatives developed during the investigation and analysis of the Sheridan Beach Collection System. Results of the findings, hydraulic analysis, and planning level cost estimates are also presented.

3.1   ALTERNATIVE 1: REMOVE THE CROSSINGS INSTALLED BY THE CITY OF SEATTLE

3.1.1   Description

This alternative involves removing the crossings installed by the City of Seattle in 1990 at NE 165th Street & Burke Gilman Trail (MH 218) and the crossing located approximately 500 feet south of this intersection along the Burke Gilman Trail (MH 239). This alternative also involves removing and replacing the existing 12-inch sewer along the Burke Gilman Trail from NE 165th Street (MH 218) to the crossing immediately south of the unused NE 160th Street right-of-way (MH 237) (Figure 1-1).

3.1.2   Results of the Hydraulic Analysis

By matching existing invert elevations at the upstream and downstream manholes, there is adequate slope to install a 12-inch sewer at minimum grade along the Burke Gilman Trail from MH 218 at NE 165th Street to MH 237. The results of the hydraulic analysis indicate that the new sewer will have adequate capacity to convey the basins re-directed as a result of the removing the crossings. The hydraulic analysis also indicates that the existing 12-inch connection should have adequate capacity to convey the additional flow to the Kenmore Lake Line using all flow generation criteria.

The detailed hydraulic analysis calculation sheet can be found in Appendix B.

3.1.3   Planning Level Cost Estimate

The planning level cost estimate for removing the crossings and installing a new sewer along the Burke Gilman Trail is approximately **$250,000.** This estimate includes an allowance for engineering, administration, and permitting.

The detailed cost estimate sheet can be found in Appendix C.

3.2 ALTERNATIVE 2: UPGRADE THE EXISTING 8-INCH LAKE LINE CONNECTION TO 12-INCH

3.2.1 Description

This alternative involves removing and replacing the existing 8-inch connection to the Kenmore Lake Line. The existing 8-inch sewer would be removed and replaced from the intersection of NE 165th Street and Shore Drive NE northward along Shore Drive NE then east to the Kenmore Lake Line. Refer to Figure 1-1. This would involve excavating within Lake Washington and most likely working below the water table along Shore Drive NE. There would also be significant permitting and environmental issues that would significantly impact the schedule and budget. There also may be cost issues maintaining sewer service in the area during construction.

3.2.2 Results of the Hydraulic Analysis

The results of the hydraulic analysis indicate that upgrading the existing 8-inch connection to the Kenmore Lake Line to 12 inches would provide adequate capacity. This is assuming that no upstream changes are made and the basins that currently flow under normal flow conditions to the 8-inch connection continue to flow the same. It would be recommended that a manhole be installed in place of the tee south of MH 095. Some modification should be made at this new manhole or to MH 232 to ensure that additional flows that normally flow to the existing 12-inch connection do not flow northward during high flow conditions. It has been determined in this hydraulic analysis that the existing 12-inch connection to the Kenmore Lake Line has adequate capacity to serve the basins which currently flow to it.

The hydraulic analysis spreadsheets for this alternative are in Appendix B.

3.2.3 Planning Level Cost Estimate

The planning level cost estimate for this alternative is **$357,000.** This involves removing and replacing the existing 8-inch sewer from NE 165th Street along Shore Drive NE, and to the Kenmore Lake Line Connection. This estimate includes an allowance for engineering and administration. An allowance of $90,000 has been included for permitting and environmental issues. This amount may be greater or less than the costs that would actually be incurred. It is believed this alternative would involve considerable permitting and environmental review in order to satisfy Endangered Species Act requirements.

3.3 ALTERNATIVE 3: INSTALL PUMP STATION AND ROUTE EXCESS FLOWS TO THE MCALEER TRUNK

3.3.1 Description

This alternative involves the installation of a small pump station along Shore Drive NE where the 8-inch sewer heads east to connect with the Kenmore Lake Line. It also involves the upgrade of the existing 8-inch gravity sewer along Shore Drive NE from NE 165th Street to the proposed pump station location. This pump station would pump the excess flow when the 8-inch sewer surcharges. The force main would run northward along Shore Drive NE, over the McAleer Creek and connect to the King County McAleer Trunk. The total length of force main would be approximately 550 feet. The general location for this work is indicated on Figure 1-1. Significant environmental concerns would have to be addressed due to the force main crossing of McAleer Creek, even if it is hung on the existing bridge.

3.3.2 Results of the Hydraulic Analysis

The results from the hydraulic analysis of the existing system indicate that the pump station would need to convey approximately 200 gpm during the peak flow conditions. This would be when the King County flow generation criteria is being applied. It is recommended that a manhole be installed north of MH 095 and modifications made to ensure that no excess flows are directed towards the 8-inch connection during high flow conditions (as discussed in Alternative #2). This would reduce the frequency of surcharging the 8-inch connection and requiring the pump station to come on-line. Not installing the manholes could require the pump station be a larger capacity than currently recommended.

3.3.3 Planning Level Cost Estimate

The planning level cost estimate for installing a package pump station with controls and emergency backup power is approximately **$768,000.** This estimate includes an allowance for engineering and administration. A permitting allowance of $90,000 has also been included to address any issues regarding crossing the McAleer Creek with the force main. The cost does <u>not</u> include an allowance for property or easement acquisition.

Estimated annual operation and maintenance costs for this alternative is approximately **$5,000** per year (year 2000 base).

3.4 ALTERNATIVE #4: RE-DIRECT BASIN G TO THE EXISTING 12-INCH CONNECTION BY INSTALLING A SEWER BETWEEN MH 016 AND MH 024 ON NE 162ND STREET

3.4.1 Description

This alternative involves the construction of a sewer upstream of the connections to direct wastewater away from the 8-inch connection and send it towards the 12-inch connection. This alternative involves construction within a residential street and does not involve extensive environmental or permitting issues. The sewer would be installed between two existing manholes (MH016 and MH 024). The 8-inch sewer would be approximately 250 feet long and 20 feet deep. Refer to Figure 1-1 for the location of the proposed sewer.

3.4.2 Results of the Hydraulic Analysis

The hydraulic analysis indicates that redirecting the flow from Basin G towards the 12-inch connection to the Kenmore Lake Line would relieve sufficient demand on the 8-inch Lake Line connection to keep it under capacity. However, it should be noted that re-routing Basin G just puts the existing 8-inch line within capacity. Using King County flow generation criteria, there would be only 10 gpm of excess capacity in this 8-inch connection. The wastewater redirected from Basin G can be as high as 150,000 gpd using King County flow generation criteria. It is recommended that a manhole be installed in-place of the tee south of MH 095. Some modifications should be made at this new manhole or to MH 232 to ensure that additional flow that normally flows to the 12-inch connection does not flow northward during high flow conditions.

It is recommended that an I&I identification and reduction program be implemented along with this alternative in order to increase the amount of excess capacity in the 8-inch connection to the Kenmore Lake Line and thus increase the reliability of the system.

The hydraulic calculation sheets can be found in Appendix B.

3.4.3 Planning Level Cost Estimate

The planning level cost estimate for this alternative is approximately **$128,000.** This estimate includes an allowance for engineering, administration, and permitting costs. This estimate does not include an allowance for an I&I identification and reduction program.

SECTION 4: ALTERNATIVE ANALYSIS

4.1 ALTERNATIVE SELECTION CRITERIA

Several alternative selection criteria have been developed in order to evaluate and compare the alternatives presented in this report. These criteria are listed below:

1. Reliability: Does the proposed project provide a high degree of reliability compared to other alternatives? What is the likelihood that this alternative will significantly reduce or eliminate the possibility of sewerage backups in the future?

2. Constructibility: Does the project present any exceptional construction difficulties?

3. Costs: What are the anticipated construction and O&M costs compared to the other alternatives?

4. Environmental Impacts: Does the proposed alternative present significant impacts to the environment? Will the proposed project require an Environmental Impact Statement or other extensive environmental reviews?

5. Permitting: What are the anticipated permits required for the project? Will this significantly impact the schedule?

6. Disturbance to Local Residents: How will the construction impact/disturb the local residents?

7. Scheduling Issues: Does the alternative have any particular features or characteristics that would greatly affect the construction schedule?

8. Potential Impacts to Other Parts of the System: Does the proposed alternative have potential impacts to other parts of the collection system?

4.2 COMPARISON OF THE ALTERNATIVES

Each of the alternatives presented in Section 3 were compared against the criteria listed above. Their comparison is summarized in Table 4-1. The table presents a brief summary of the comparisons in order to highlight their differences.

Table 4-1: Comparison of Alternatives

Alternative	Reliability	Constructibility	Est. Costs	Environmental Impacts	Permitting	Schedule (Estimate)	Impacts to Exist. Syst.	Disturbance to Local Residents
1. Remove Crossings & Install New Sewer Along Burke Gilman Trail	Would reduce capacity problem at 8-inch Lake Line connection.	Would involve construction along the trail. Some access issues.	$250K	Minimal, DNS – 3 to 6 mos.	Would need SEPA & Parks Permit	Pmt. Esmt, 3 months design, 3 months const, 9-12 mos.permit	Would direct more flow to 12-inch connection.	Would affect use of the trail. Trail traffic would have to be detoured.
2. Upgrade 8-inch Connection to Lake Line	Would reduce capacity problem at 8–inch Lake Line connection. Would not need to make any upstream changes	Difficult. Would involve working within the Lake, connecting to the Lake Line, and maintaining service.	$357K	High	Extensive	1 year design, 2 years permitting, 4 months const.	Minimal. Would not redirect any flows.	High. Would involve construction within an easement between two developed lots.
3. Pump Station to McAleer Trunk	Would redirect excess flows to the McAleer Trunk when the 8-inch Lake Line connection begins to surcharge.	Difficult. Would involve constructing a new PS or refurbishing existing PS within street R/W.	$768K Const. $5K/yr O&M	Moderate. Would involve installing force main over McAleer Creek on Bridge.	Extensive	1 year design, 1 year permitting, 6 months const.	Would direct flows to the McAleer Trunk. Would not affect local collection system.	Would involve construction within R/W in front of homes and in-street for force main.
4. Redirect Basin G Flows	Would reduce capacity problems at 8-inch Lake Line connection. Would need to institute I/I monitoring & reduction program to gain further additional capacity at 8-in. conn.	Minimal. Would involve installing a new sewer within street R/W.	$128K	Minimal. Construction within street R/W.	SEPA and R/W permit.	3 months design, 3 months construct., 3 mos permitting	Would direct Basin G Flows to 12-inch Lake Line connection.	Would involve temporary traffic control during construction.

SECTION 5: RECOMMENDED ALTERNATIVE

5.1 RECOMMENDED ALTERNATIVE

On August 11, 2000, a meeting of the stakeholders was held at the City of Lake Forest Park. In that meeting, all alternatives and selection criteria were presented and discussed. At the conclusion of that meeting, it was agreed that Alternative #4 – Re-Direct Basin G to the Existing 12-inch Connection be implemented with a multiple phase approach. It was agreed that this alternative is the most favorable considering costs, schedule, permitting, and environmental impacts. This alternative should also provide a high degree of reliability for the local system when implemented.

This recommended alternative should be implemented in the following manner:

- **Phase I: Construct Sewer:** Construct the sewer between MH 016 and MH 024 on NE 162nd Street. This should be designed and constructed as soon as possible in order to reduce the flow towards the 8-inch Lake Line connection.

- **Phase II: Implement Flow/Odor Control Measures:** It has been discussed that there is the potential for flow to be directed northward towards the 8-inch connection from MH 095 during high flow events. A solution will need to be implemented which will prevent flow from backing up and heading northwards towards the 8-inch connection. Some field study that might include dye tests should be conducted in order to confirm the direction of flow and the behavior of the system. Solutions could be as simple as plugging the pipe in the vicinity of MH 095 or MH 232 (to the north). Other solutions could include installing one or two additional manholes in order to replace the tee connection immediately south of MH 095. Modifications could be made to the piping in order to reduce or eliminate the likelihood of flow going northward. Odor issues near the 12-inch connection will be monitored and modifications developed if necessary to mitigate any odors that might be caused by additional wastewater flows.

- **Phase III: Institute an I&I Investigation and Reduction Program:** Although the recommended alternative eliminates surcharging of local sewer lines under all of the flow modeling assumptions used in this report and outlined in Section 2, I&I reduction would further improve the reliability of this recommended alternative. In order to assure the highest possible degree of reliability, an I&I investigation and reduction program should be implemented. King County is in the midst of a multi-year program to work with local sewer agencies to reduce I&I throughout the area served by King County. This I&I reduction effort may be necessary to assure that these improvements provide adequate capacity and reliability within the system.

5.2   HYDRAULIC IMPLICATIONS

This section outlines the various hydraulic implications resulting from the recommended alternative.

5.2.1   Hydraulic Capacity of the 12-inch Connection to the Lake Line

The existing 12-inch connection (from the Kenmore Lake Line to the Burke Gilman Trail) has a capacity of approximately 4,100 gpm assuming free-discharge into the Kenmore Lake Line. Using King County flow generation criteria (the most conservative) under the existing system configuration, there could be approximately 364-gpm of flow through the line during peak flow conditions. This peak flow results in excess capacity of approximately 3,700 gpm using King County flow generation criteria.

Installing the sewer and re-directing Basin G flows towards the 12-inch connection would result in a peak flow of approximately 555 gpm flow through this line. This peak flow results in excess capacity of approximately 3,500 gpm using King County flow generation criteria and assuming free-discharge into the Kenmore Lake Line.

The resulting net increase in flow to the 12-inch connection is estimated at 191 gpm under peak flow conditions.

5.2.2   Maximum Estimated Capacity in 8-inch Lake Line Connection

The capacity calculations for the analysis have been conducted assuming open-channel gravity flow within the pipes with a free-discharge into the Kenmore Lake Line. However, additional capacity could be conveyed through the collection pipes under surcharged conditions. The 8-inch connection and the upstream sewer pipes were analyzed assuming surcharged pipe conditions to see how much additional flow could be conveyed through the system. This analysis was performed assuming Basin G flows would be conveyed to the 12-inch Lake Line Connection. Once the maximum capacity under pressurized flow was determined, an equivalent I&I rate was calculated.

The Hazen-Williams Equation was used to conduct the surcharged pipe calculation. The equation is as follows:

$$H_f = 10.44 \ L \ (gpm^{1.85}/(C^{1.85} \ d_{inches}^{4.8655}))$$

Where: H_f = Friction Loss in Feet

                       L = Length of Pipe in Feet

                       C = Hazen-Williams friction coefficient (100)

This analysis was conducted assuming free-discharge into the Kenmore Lake Line and the maximum hydraulic grade line within the collection system set at 4 feet above the manhole inverts. The sewer cards were checked and it was estimated that a 4-foot hydraulic grade line could be attained without backing wastewater up into floor drains in the homes along Shore Drive NE.

The system was analyzed using the same number of sanitary units entering the system at the designated manholes as was modeled using Alternative #4, (i.e.) Basin G flows are directed to the 12-inch Lake Line connection and basin A through F flows are directed towards the 8-inch Lake Line connection. Sanitary flow was generated using King County wastewater flow criteria (3.2 people/parcel, 60 gpcd, peaking factor of 3.0 for 1,000 upstream acres and 4.0 for 100 upstream acres). The I&I rate (in gpad) was increased until sufficient flow was being conveyed through the system that the hydraulic grade line would reach 4-feet above the manhole inverts.

This analysis determined that an I&I rate of 4,200 gpad under free-discharge conditions could be conveyed by the system before the hydraulic grade line would come to the threshold limit of 4 feet above the identified manhole inverts. This provides an additional 1,300 gpad of I&I that could be conveyed by the system after the Alternative #4 sewer has been installed (this is above the 2,900 gpad of I&I used in the King County flow generation criteria).

5.2.3 Capacity Within the King County Kenmore Lake Line

King County has implemented a number of projects over the past decade to divert wastewater away from and otherwise reduce peak flows to the Kenmore Lake Line. These projects are documented in the information provided by King County in Appendix D. According to this information, these wastewater diversion and peak flow reduction measures should provide sufficient capacity to convey the peak 20-year flow through 2010 when the Brightwater Treatment Plant is scheduled to be completed. After completion of this treatment plant, the majority of flows will be diverted from the Kenmore Lake Line, which will then serve only a limited area along the shore of Lake Washington. In accordance with the County's information regarding the availability of capacity within the Kenmore Lake Line, the analyses outlined in this report and provided in Appendix B were conducted assuming free-discharge into the Lake Line.

Additionally, HDR, Inc. prepared a technical memorandum summarizing capacity calculations within the local collection system based on information from a local system model developed by King County. This memorandum, which is included in Appendix E, outlines the potential hydraulic grade lines at key locations within the collection system under various surcharged conditions within the Kenmore Lake Line.

APPENDIX A:
MANHOLE MAP

DETAIL A
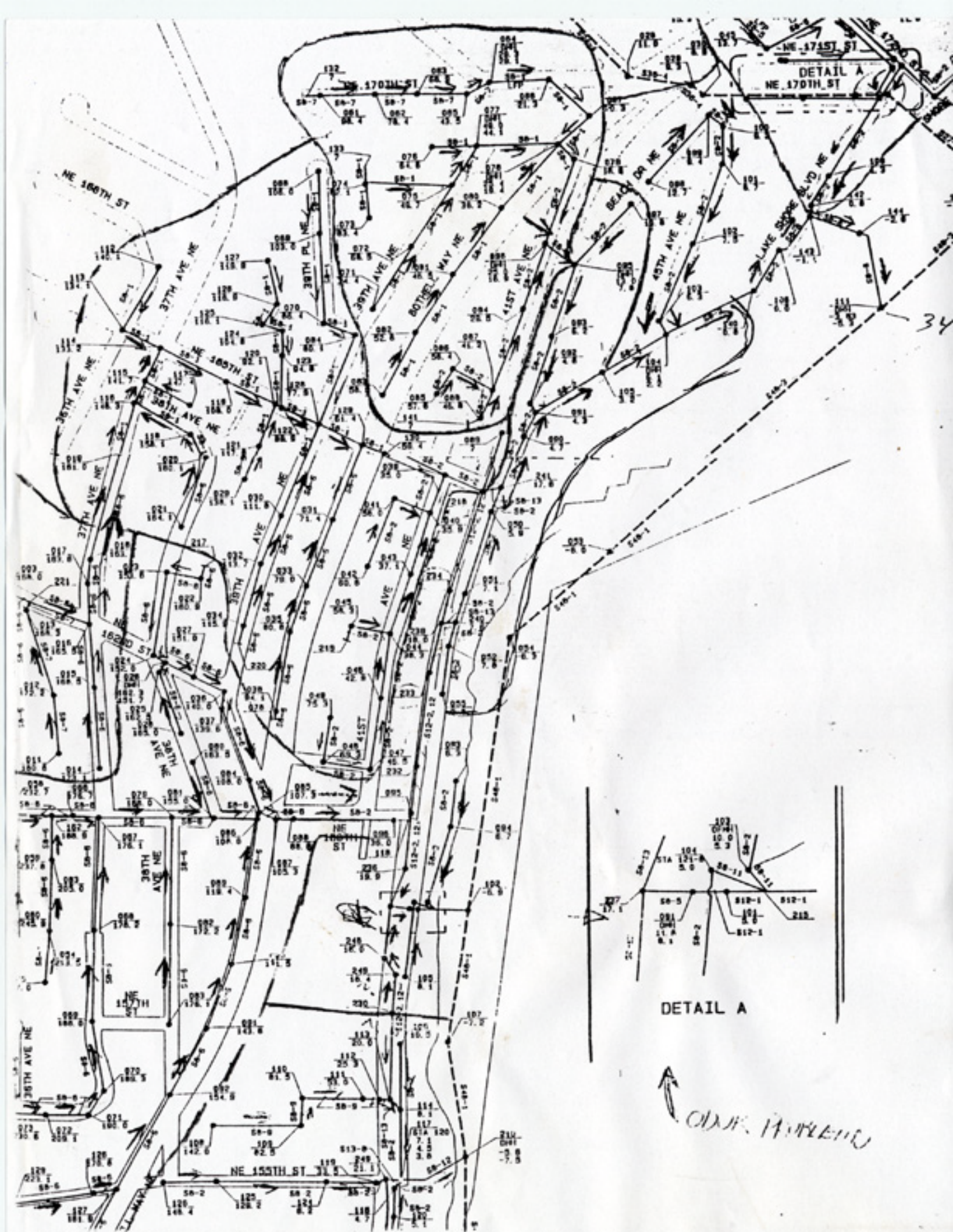
APPENDIX B
HYDRAULIC CALCULATIONS

Sheridan Beach Collection System Analysis
Summary of Flow Criteria and Capacity Calculations

Existing Condition: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection

Pipe Data			King County Criteria			Lake Forest Park Criteria			Shoreline WWD Criteria #1			Shoreline WWD Criteria #2			City of Seattle Criteria		
Upstream Manhole	Downstream Manhole	Capacity (gpm)	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status
095	232	NS	8	NS	NS	5	NS	NS	5	NS	NS	6	NS	NS	4	NS	NS
232	233	453	8	444	OK	5	448	OK	5	447	OK	6	447	OK	4	449	OK
233	239	1761	8	1752	OK	5	1756	OK	5	1756	OK	6	1755	OK	4	1757	OK
239	240	2490	8	2481	OK	5	2484	OK	5	2484	OK	6	2484	OK	4	2485	OK
240	051	375	47	328	OK	27	348	OK	35	340	OK	39	337	OK	22	353	OK
051	050	347	47	300	OK	27	319	OK	35	312	OK	39	308	OK	22	324	OK
050	241	447	47	401	OK	27	420	OK	35	413	OK	39	409	OK	22	425	OK
241	090	295	386	-91	Over Capacity	221	75	OK	306	-11	Over Capacity	341	-45	Over Capacity	184	112	OK
090	091	344	386	-43	Over Capacity	221	123	OK	306	38	OK	341	3	OK	184	160	OK
091	105	344	500	-156	Over Capacity	284	60	OK	403	-60	Over Capacity	450	-106	Over Capacity	238	106	OK
105	104	337	500	-162	Over Capacity	284	53	OK	403	-66	Over Capacity	450	-113	Over Capacity	238	100	OK
104	140	346	528	-182	Over Capacity	300	47	OK	429	-83	Over Capacity	479	-132	Over Capacity	251	95	OK
140	106	378	528	-150	Over Capacity	300	79	OK	429	-50	Over Capacity	479	-100	Over Capacity	251	127	OK
106	143	437	528	-91	Over Capacity	300	137	OK	429	8	OK	479	-41	Over Capacity	251	186	OK
143	144	483	596	-113	Over Capacity	338	145	OK	387	96	OK	542	-59	Over Capacity	284	199	OK
144	111	360	596	-236	Over Capacity	338	22	OK	387	-27	Over Capacity	542	-182	Over Capacity	284	76	OK

Existing Condition: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection

Pipe Data			King County Criteria			Lake Forest Park Criteria			Shoreline WWD Criteria #1			Shoreline WWD Criteria #2			City of Seattle Criteria		
Upstream Manhole	Downstream Manhole	Capacity (gpm)	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status
024	026	421	108	313	OK	18	403	OK	59	362	OK	46	375	OK	17	404	OK
026	027	434	108	325	OK	18	416	OK	59	375	OK	46	388	OK	17	417	OK
027	036	1646	108	1537	OK	18	1628	OK	59	1587	OK	46	1600	OK	17	1629	OK
036	037	426	108	318	OK	18	408	OK	59	368	OK	46	381	OK	17	410	OK
037	084	1826	108	1718	OK	18	1808	OK	59	1767	OK	46	1780	OK	17	1809	OK
084	085	407	108	299	OK	18	389	OK	59	348	OK	46	361	OK	17	390	OK
085	087	953	306	648	OK	171	783	OK	365	588	OK	285	668	OK	144	809	OK
087	088	2755	306	2449	OK	171	2584	OK	365	2390	OK	285	2470	OK	144	2611	OK
088	096	2107	306	1801	OK	171	1936	OK	365	1742	OK	285	1822	OK	144	1963	OK
096	Tee118	2900	364	2537	OK	203	2697	OK	432	2468	OK	337	2563	OK	171	2729	OK
Tee118	236	777	364	414	OK	203	574	OK	432	345	OK	337	440	OK	171	606	OK
236	237	769	364	405	OK	203	565	OK	432	337	OK	337	431	OK	171	597	OK
237	091	1496	364	1132	OK	203	1292	OK	432	1064	OK	337	1158	OK	171	1324	OK
091	101	5151	364	4788	OK	203	4948	OK	432	4719	OK	337	4814	OK	171	4980	OK
101	102	4120	364	3757	OK	203	3917	OK	432	3688	OK	337	3783	OK	171	3949	OK

Criteria Summary:

3.2 People/Parcel	2.4 People/Parcel	12 People/Populated Acre, 77% area populated
60 gpcd	85 gpcd	85 gpcd
2,900 gpad	1,100 gpad	1,100 gpad
Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 3.0	Peaking Factor: 3.0 for 1,000 upstream acres
4.0 for 100 upstream acres		4.0 for 100 upstream acres

12 People/Populated Acre, 77% area populated	2.5 People/parcel
60 gpcd	60 gpcd
2,500 gpad	1,200 gpad
Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 2.8
4.0 for 100 upstream acres	

Sheridan Beach Collection System Analysis
Summary of Flow Criteria and Capacity Calculations

Proposed Alternative #4: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection. Includes Connection Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are Included.

Pipe Data			King County Criteria			Lake Forest Park Criteria			Shoreline WWD Criteria #1			Shoreline WWD Criteria #2			City of Seattle Criteria		
Upstream Manhole	Downstream Manhole	Capacity (gpm)	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status
016	024	1263	195	1068	OK	114	1149	OK	144	1119	OK	161	1102	OK	93	1170	OK
024	026	421	232	189	OK	132	289	OK	186	235	OK	206	215	OK	110	311	OK
026	027	434	232	202	OK	132	302	OK	186	248	OK	206	227	OK	110	324	OK
027	036	1646	232	1414	OK	132	1514	OK	186	1460	OK	206	1439	OK	110	1536	OK
036	037	426	232	194	OK	132	295	OK	186	241	OK	206	220	OK	110	316	OK
037	084	1826	232	1594	OK	132	1694	OK	186	1640	OK	206	1620	OK	110	1716	OK
084	085	407	232	175	OK	132	275	OK	186	221	OK	206	200	OK	110	297	OK
085	087	953	498	455	OK	285	669	OK	398	556	OK	443	510	OK	237	716	OK
087	088	2755	498	2257	OK	285	2470	OK	398	2357	OK	443	2312	OK	237	2518	OK
088	096	2107	498	1609	OK	285	1823	OK	398	1709	OK	443	1664	OK	237	1870	OK
096	Tee118	2900	555	2345	OK	317	2583	OK	443	2457	OK	495	2406	OK	265	2636	OK
Tee118	236	777	555	223	OK	317	460	OK	443	334	OK	495	283	OK	265	513	OK
236	237	769	555	214	OK	317	452	OK	443	326	OK	495	274	OK	265	504	OK
237	091	1496	555	941	OK	317	1178	OK	443	1053	OK	495	1001	OK	265	1231	OK
091	101	5151	555	4597	OK	317	4834	OK	443	4708	OK	495	4657	OK	265	4887	OK
101	102	4120	555	3566	OK	317	3803	OK	443	3677	OK	495	3626	OK	265	3856	OK

Proposed Alternative #4: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection, Includes Connection Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are removed

Pipe Data			King County Criteria			Lake Forest Park Criteria			Shoreline WWD Criteria #1			Shoreline WWD Criteria #2			City of Seattle Criteria		
Upstream Manhole	Downstream Manhole	Capacity (gpm)	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status
095	232	NS	8	NS	NS	5	NS	NS	5	NS	NS	6	NS	NS	4	NS	NS
232	233	453	8	444	OK	5	448	OK	5	447	OK	6	447	OK	4	449	OK
233	239	1761	8	1752	OK	5	1756	OK	5	1756	OK	6	1755	OK	4	1757	OK
239	240	2490	8	2481	OK	5	2484	OK	5	2484	OK	6	2484	OK	4	2485	OK
240	051	375	47	328	OK	27	348	OK	68	307	OK	39	337	OK	22	353	OK
051	050	347	47	300	OK	27	319	OK	68	279	OK	39	308	OK	22	324	OK
050	241	447	47	401	OK	27	420	OK	68	380	OK	39	409	OK	22	425	OK
241	090	295	192	103	OK	107	189	OK	162	133	OK	180	115	OK	90	205	OK
090	091	344	192	152	OK	107	237	OK	162	182	OK	180	164	OK	90	254	OK
091	105	344	307	37	OK	170	174	OK	262	82	OK	292	52	OK	144	200	OK
105	104	337	307	30	OK	170	167	OK	262	75	OK	292	46	OK	144	193	OK
104	140	346	337	10	OK	186	160	OK	289	58	OK	321	25	OK	158	188	OK
140	106	378	337	42	OK	186	193	OK	289	90	OK	321	57	OK	158	221	OK
106	143	437	337	101	OK	186	251	OK	289	149	OK	321	116	OK	158	279	OK
143	144	483	405	78	OK	224	258	OK	346	137	OK	386	97	OK	191	292	OK
144	111	360	405	-45	Over Capacity	224	136	OK	346	14	OK	386	-25	Over Capacity	191	170	OK

Criteria Summary:

	King County Criteria	Lake Forest Park Criteria	Shoreline WWD Criteria #1	Shoreline WWD Criteria #2	City of Seattle Criteria
	3.2 People/Parcel	2.4 People/Parcel	12 People/Populated Acre, 77% area populated	12 People/Populated Acre, 77% area populated	2.5 People/parcel
	60 gpcd	85 gpcd	85 gpcd	60 gpcd	60 gpcd
	2,900 gpad	1,100 gpad	1,100 gpad	2,500 gpad	1,200 gpad
	Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 3.0	Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 2.8
	4.0 for 100 upstream acres		4.0 for 100 upstream acres	4.0 for 100 upstream acres	

Sheridan Beach Collection System Analysis
Summary of Flow Criteria and Capacity Calculations

Proposed Alternative #2: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection. Upgrade Existing 8-inch Sewer with a 12-inch Sewer Along Lake Shore Blvd. @ NE 165th St. to Lake Line Connection

Pipe Data			King County Criteria			Lake Forest Park Criteria			Shoreline WWD Criteria #1			Shoreline WWD Criteria #2			City of Seattle Criteria		
Upstream Manhole	Downstream Manhole	Capacity (gpm)	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status
095	232	NS	8	NS	NS	7	NS	NS	5	NS	NS	6	NS	NS	4	NS	NS
232	233	453	8	444	OK	7	445	OK	5	447	OK	6	447	OK	4	449	OK
233	239	1761	8	1752	OK	7	1753	OK	5	1756	OK	6	1755	OK	4	1757	OK
239	240	2490	8	2481	OK	7	2482	OK	5	2484	OK	6	2484	OK	4	2485	OK
240	051	375	47	328	OK	42	333	OK	35	340	OK	25	350	OK	22	353	OK
051	050	347	47	300	OK	42	305	OK	35	312	OK	25	322	OK	22	324	OK
050	241	447	47	401	OK	42	405	OK	35	413	OK	25	422	OK	22	425	OK
241	090	870	386	484	OK	351	520	OK	306	564	OK	341	530	OK	184	687	OK
090	091	1013	386	627	OK	351	663	OK	306	707	OK	341	673	OK	184	830	OK
091	105	1013	500	514	OK	456	557	OK	403	610	OK	450	564	OK	238	776	OK
105	104	994	500	494	OK	456	537	OK	403	591	OK	450	544	OK	238	756	OK
104	140	1021	528	493	OK	483	537	OK	429	592	OK	479	542	OK	251	770	OK
140	106	1116	528	588	OK	483	632	OK	429	687	OK	479	637	OK	251	865	OK
106	143	1289	528	761	OK	483	806	OK	429	860	OK	479	810	OK	251	1038	OK
143	144	1424	596	828	OK	547	877	OK	485	939	OK	542	882	OK	284	1140	OK
144	111	1062	596	466	OK	547	515	OK	485	577	OK	542	520	OK	284	778	OK

Proposed Alternative #1: Remove Crossings and Re-Dig Sewer Along the Burke Gilman Trail from NE 165th St. and Lake Shore Blvd to NE 160th Street.

Pipe Data			King County Criteria			Lake Forest Park Criteria			Shoreline WWD Criteria #1			Shoreline WWD Criteria #2			City of Seattle Criteria		
Upstream Manhole	Downstream Manhole	Capacity (gpm)	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status	Total Peak Flow(gpm)	Capacity Difference	Status
218	095	706	348	358	OK	198	507	OK	277	429	OK	308	398	OK	265	441	OK
095	237	706	648	59	OK	369	337	OK	524	182	OK	587	120	OK	509	197	OK
237	091	1496	703	792	OK	402	1094	OK	569	927	OK	637	858	OK	554	941	OK
091	101	5151	703	4448	OK	402	4750	OK	569	4583	OK	637	4514	OK	554	4597	OK
101	102	4120	703	3417	OK	402	3719	OK	569	3552	OK	637	3483	OK	554	3566	OK

Criteria Summary:					
	3.2 People/Parcel	2.4 People/Parcel	12 People/Populated Acre, 77% area populated	12 People/Populated Acre, 77% area populated	2.5 People/parcel
	60 gpcd	85 gpcd	85 gpcd	60 gpcd	60 gpcd
	2,900 gpad	1,100 gpad	1,100 gpad	2,500 gpad	1,200 gpad
	Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 3.0	Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 3.0 for 1,000 upstream acres	Peaking Factor: 2.8
	4.0 for 100 upstream acres		4.0 for 100 upstream acres	4.0 for 100 upstream acres	

Sheridan Beach Collection System Analysis
Basin Flow Estimates

King County Criteria:

3.2 People per parcel
60 gallons per capita per day
2,900 gallons per day per acre

Peaking Factor:
(Calculated on Capacity
Calculation Sheets)

upstream area	p.f.
acres	
1,000	3
100	4

Basin	Approximate #of Parcels	Approximate Area (Ac.)	Estimated Population	Est. Sanitary Flow (gpd)	Est. I&I (gpd)	Unpeaked Basin Flow (gpd)
A	55	20	176	10,560	58,000	**68,560**
B	34	10	109	6,528	29,000	**35,528**
C	21	9	67	4,032	26,100	**30,132**
D	11	6	35	2,112	17,400	**19,512**
E	77	28	246	14,784	81,200	**95,984**
F	118	45	378	22,656	130,500	**153,156**
G	180	49	576	34,560	142,100	**176,660**
H	48	16	154	9,216	46,400	**55,616**
I	150	52	480	28,800	150,800	**179,600**
J	95	35	304	18,240	101,500	**119,740**
Part F	9	1.77	29	1,728	5,133	**6,861**
Part I	17	14	54	3,264	40,600	**43,864**

City of Lake Forest Park Criteria: Peaking Factor: 3.0

2.4 People per parcel
85 gallons per capita per day
1,100 gallons per day per acre

Basin	Approximate #of Parcels	Approximate Area (Ac.)	Estimated Population	Est. Sanitary Flow (gpd)	Est. I&I (gpd)	Unpeaked Basin Flow (gpd)	Total Basin Flow (gpd), Peaked
A	55	20	132	11,220	22,000	**33,220**	**55,660**
B	34	10	82	6,936	11,000	**17,936**	**31,808**
C	21	9	50	4,284	9,900	**14,184**	**22,752**
D	11	6	26	2,244	6,600	**8,844**	**13,332**
E	77	28	185	15,708	30,800	**46,508**	**77,924**
F	118	45	283	24,072	49,500	**73,572**	**121,716**
G	180	49	432	36,720	53,900	**90,620**	**164,060**
H	48	16	115	9,792	17,600	**27,392**	**46,976**
I	150	52	360	30,600	57,200	**87,800**	**149,000**
J	95	35	228	19,380	38,500	**57,880**	**96,640**
Part F	9	1.77	22	1,836	1,947	**3,783**	**7,455**
Part I	17	14	41	3,468	15,400	**18,868**	**25,804**

Shoreline WMD Criteria #1:
12 People per populated acre
85 gallons per capita per day
1,100 gallons per day per acre
77% of a Basin's area is populated

Peaking Factor:
(Calculated on Capacity
Calculation Sheets)

upstream area	p.f.
acres	
1,000	3
100	4

Basin	Approximate Area (Ac.)	Populated Area (Ac.)	Estimated Population	Est. Sanitary Flow (gpd)	Est. I&I (gpd)	Unpeaked Basin Flow (gpd)
A	20	15	185	15,708	22,000	**37,708**
B	10	8	92	7,854	11,000	**18,854**
C	9	7	83	7,069	9,900	**16,969**
D	6	5	55	4,712	6,600	**11,312**
E	28	22	259	21,991	30,800	**52,791**
F	45	35	416	35,343	49,500	**84,843**
G	49	38	453	38,485	53,900	**92,385**
H	16	12	148	12,566	17,600	**30,166**
I	52	40	480	40,841	57,200	**98,041**
J	35	27	323	27,489	38,500	**65,989**
Part F	1.77	1	16	1,390	1,947	**3,337**
Part I	14	11	129	10,996	15,400	**26,396**

Shoreline WMD Criteria #2:
12 People per populated acre
60 gallons per capita per day
2,500 gallons per day per acre
77% of a Basin's area is populated

Peaking Factor:
(Calculated on Capacity
Calculation Sheets)

upstream area	p.f.
acres	
1,000	3
100	4

Basin	Approximate Area (Ac.)	Populated Area (Ac.)	Estimated Population	Est. Sanitary Flow (gpd)	Est. I&I (gpd)	Unpeaked Basin Flow (gpd)
A	20	15	185	11,088	50,000	**61,088**
B	10	8	92	5,544	25,000	**30,544**
C	9	7	83	4,990	22,500	**27,490**
D	6	5	55	3,326	15,000	**18,326**
E	28	22	259	15,523	70,000	**85,523**
F	45	35	416	24,948	112,500	**137,448**
G	49	38	453	27,166	122,500	**149,666**
H	16	12	148	8,870	40,000	**48,870**
I	52	40	480	28,829	130,000	**158,829**
J	35	27	323	19,404	87,500	**106,904**
Part F	1.77	1	16	981	4,425	**5,406**
Part I	14	11	129	7,762	35,000	**42,762**

City of Seattle Criteria: Peaking Factor: 2.8

2.5 People per parcel
60 gallons per capita per day
1,200 gallons per day per acre

Basin	Approximate #of Parcels	Approximate Area (Ac.)	Estimated Population	Est. Sanitary Flow (gpd)	Est. I&I (gpd)	Unpeaked Basin Flow (gpd)	Total Basin Flow (gpd), Peaked
A	55	20	138	8,250	24,000	**32,250**	**47,100**
B	34	10	85	5,100	12,000	**17,100**	**26,280**
C	21	9	53	3,150	10,800	**13,950**	**19,620**
D	11	6	28	1,650	7,200	**8,850**	**11,820**
E	77	28	193	11,550	33,600	**45,150**	**65,940**
F	118	45	295	17,700	54,000	**71,700**	**103,560**
G	180	49	450	27,000	58,800	**85,800**	**134,400**
H	48	16	120	7,200	19,200	**26,400**	**39,360**
I	150	52	375	22,500	62,400	**84,900**	**125,400**
J	95	35	238	14,250	42,000	**56,250**	**81,900**
Part F	9	1.77	23	1,350	2,124	**3,474**	**5,904**
Part I	17	14	43	2,550	16,800	**19,350**	**23,940**

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Existing Condition: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection
King County Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	1.20	4.00	5	3.56	8.36	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	1.20	4.00	5	3.56	8.36	444	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	1.20	4.00	5	3.56	8.36	1752	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	1.20	4.00	5	3.56	8.36	2481	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	5.73	4.00	23	23.70	46.64	328	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	5.73	4.00	23	23.70	46.64	300	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	5.73	4.00	23	23.70	46.64	401	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F,G	104	44.27	4.00	177	209.44	386.31	-91	Over Capacity
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F,G	104	44.27	4.00	177	209.44	386.31	-43	Over Capacity
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F,G	138	56.00	3.96	222	277.92	499.55	-156	Over Capacity
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F,G	138	56.00	3.96	222	277.92	499.55	-162	Over Capacity
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F,G	147	58.80	3.95	232	296.04	528.17	-182	Over Capacity
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F,G	147	58.80	3.95	232	296.04	528.17	-150	Over Capacity
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F,G	147	58.80	3.95	232	296.04	528.17	-91	Over Capacity
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F,G	167	66.13	3.93	260	336.32	595.93	-113	Over Capacity
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F,G	167	66.13	3.93	260	336.32	595.93	-236	Over Capacity
Total				3213														

Existing Condition: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection
King County Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	Part I	14	20.00	4.00	80	28.19	108.19	313	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	Part I	14	20.00	4.00	80	28.19	108.19	325	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	Part I	14	20.00	4.00	80	28.19	108.19	1537	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	Part I	14	20.00	4.00	80	28.19	108.19	318	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	Part I	14	20.00	4.00	80	28.19	108.19	1718	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	Part I	14	20.00	4.00	80	28.19	108.19	299	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	I, J	87	32.67	4.00	131	175.21	305.88	648	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	I, J	87	32.67	4.00	131	175.21	305.88	2449	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	I, J	87	32.67	4.00	131	175.21	305.88	1801	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	I, J, H	103	39.07	4.00	156	207.43	363.57	2537	OK
Tee118	20.3	236	19.9	170	0.0024	12	0.79	1.732	777	I, J, H	103	39.07	4.00	156	207.43	363.57	414	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	I, J, H	103	39.07	4.00	156	207.43	363.57	405	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	I, J, H	103	39.07	4.00	156	207.43	363.57	1132	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	I, J, H	103	39.07	4.00	156	207.43	363.57	4788	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	I, J, H	103	39.07	4.00	156	207.43	363.57	3251	OK

Note: NS = Negative Slope

4/3/01

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #2: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection. Upgrade Existing 8-inch Sewer with 12-inch Sewer Along Lake Shore Blvd. @ NE 165th St. to Lake Line Connection
King County Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	1.20	4.00	5	3.56	8.36	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	1.20	4.00	5	3.56	8.36	444	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	1.20	4.00	5	3.56	8.36	1752	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	1.20	4.00	5	3.56	8.36	2481	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	5.73	4.00	23	23.70	46.64	328	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	5.73	4.00	23	23.70	46.64	300	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	5.73	4.00	23	23.70	46.64	401	OK
241	5.29	090	4.7	200	0.0030	12	0.79	1.939	870	B,F,G	104	44.27	4.00	177	209.44	386.31	484	OK
090	4.7	091	4.3	100	0.0040	12	0.79	2.258	1013	B,F,G	104	44.27	4.00	177	209.44	386.31	627	OK
091	4.3	105	3.2	275	0.0040	12	0.79	2.258	1013	B,D,E,F,G	138	56.00	3.96	222	277.92	499.55	514	OK
105	3.2	104	2.2	260	0.0038	12	0.79	2.214	994	B,D,E,F,G	138	56.00	3.96	222	277.92	499.55	494	OK
104	2.2	140	0.8	345	0.0041	12	0.79	2.275	1021	B,C,D,E,F,G	147	58.80	3.95	232	296.04	528.17	493	OK
140	0.8	106	0	165	0.0048	12	0.79	2.486	1116	B,C,D,E,F,G	147	58.80	3.95	232	296.04	528.17	588	OK
106	0	143	-1.1	170	0.0065	12	0.79	2.872	1289	B,C,D,E,F,G	147	58.80	3.95	232	296.04	528.17	761	OK
143	-1.1	144	-2.6	190	0.0079	12	0.79	3.173	1424	A,B,C,D,E,F,G	167	66.13	3.93	260	336.32	595.93	828	OK
144	-2.6	111	-3.83	280	0.0044	12	0.79	2.367	1062	A,B,C,D,E,F,G	167	66.13	3.93	260	336.32	595.93	466	OK
Total				3213														

Proposed Alternative #1: Remove Crossings and Re-Dig Sewer Along the Burke Gilman Trail from NE 165th St. and Lake Shore Blvd to NE 160th Street.
King County Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
218	20.06	**095**	17.8	1175	0.0019	12	0.79	1.573	706	F, G	94	40	4.00	159	189.31	348.24	358	OK
095	17.8	**237**	17.1	350	0.0019	12	0.79	1.574	706	F, G, I, J	181	72.40	3.91	283	364.51	647.60	59	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	F, G, I, J, H	197	78.80	3.89	307	396.74	703.44	792	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	F, G, I, J, H	197	78.80	3.89	307	396.74	703.44	4448	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	F, G, I, J, H	197	78.80	3.89	307	396.74	703.44	2912	OK
				1805														

Note: NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #4: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection. Includes Connection Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are Included.
King County Flow Criteria
    Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity		Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm		Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
016	165.5	**024**	152.0	250	0.0540	8	0.35	2.814	1263		G	49	24	4.00	96	98.68	194.68	1068	OK
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421		G, Part I	63	26.27	4.00	105	126.88	231.94	189	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434		G, Part I	63	26.27	4.00	105	126.88	231.94	202	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646		G, Part I	63	26.27	4.00	105	126.88	231.94	1414	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426		G, Part I	63	26.27	4.00	105	126.88	231.94	194	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826		G, Part I	63	26.27	4.00	105	126.88	231.94	1594	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407		G, Part I	63	26.27	4.00	105	126.88	231.94	175	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953		G, I, J	136	56.67	3.96	224	273.89	498.29	455	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755		G, I, J	136	56.67	3.96	224	273.89	498.29	2257	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107		G, I, J	136	56.67	3.96	224	273.89	498.29	1609	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900		G, I, J, H	152	63.07	3.94	249	306.11	554.73	2345	OK
Tee118	20.3	236	19.9	170	0.0024	12	0.79	1.732	777		G, I, J, H	152	63.07	3.94	249	306.11	554.73	223	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769		G, I, J, H	152	63.07	3.94	249	306.11	554.73	214	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496		G, I, J, H	152	63.07	3.94	249	306.11	554.73	941	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151		G, I, J, H	152	63.07	3.94	249	306.11	554.73	4597	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615		G, I, J, H	152	63.07	3.94	249	306.11	554.73	3060	OK
Total				2125															

Proposed Alternative #4: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection, Includes Crossing Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are removed
King County Flow Criteria
    Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity		Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm		Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS		Part F	2	1.20	4.00	5	3.56	8.36	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453		Part F	2	1.20	4.00	5	3.56	8.36	444	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761		Part F	2	1.20	4.00	5	3.56	8.36	1752	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490		Part F	2	1.20	4.00	5	3.56	8.36	2481	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375		Part F,B	12	5.73	4.00	23	23.70	46.64	328	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347		Part F,B	12	5.73	4.00	23	23.70	46.64	300	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447		Part F,B	12	5.73	4.00	23	23.70	46.64	401	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295		B,F	55	20.27	4.00	81	110.76	191.83	103	OK
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344		B,F	55	20.27	4.00	81	110.76	191.83	152	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344		B,D,E,F	89	32.00	4.00	128	179.24	307.24	37	OK
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337		B,D,E,F	89	32.00	4.00	128	179.24	307.24	30	OK
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346		B,C,D,E,F	98	34.80	4.00	139	197.36	336.56	10	OK
140	0.8	106	0	165	0.0048	8	0.35	0.843	378		B,C,D,E,F	98	34.80	4.00	139	197.36	336.56	42	OK
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437		B,C,D,E,F	98	34.80	4.00	139	197.36	336.56	101	OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483		A,B,C,D,E,F	118	42.13	3.98	168	237.64	405.33	78	OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360		A,B,C,D,E,F	118	42.13	3.98	168	237.64	405.33	-45	Over Capacity
Total				3213															

Note: NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Pressurized Pipe Analysis
Proposed Alternative #4: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection, Includes Crossing Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are removed
Assumes Free Discharge into Kenmore Lake Line

C = 100

Manhole Data				Pipe Data			Hydraulic Calculations - Hazen Williams Equation					Flow Calculations		I & I Rate (gpad)	4200				Ent/Exit Losses Through Manholes			
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Flow	Friction	Hgl	Max. Allow. Hgl	Difference	Upstream Basins	Upstream Acreage	Base Sanitary Flow (gpm)	Peaking Factor	Peak Sanitary Flow (gpm)	Calc. I & I gpm	Total Peak Flow (gpm)	Area s.f.	Flow CFS	Velocity Ft/sec	Ent/Ext Losses
	feet		feet	feet		inches	(gpm)	(ft)	(ft)	(ft)	(ft)											
095	20.26	232	20.39	123	-0.0011	12	9.96	0.000101	9.30	24.26	14.96	Part F	2	1.2	4.00	4.80	5.16	9.96	0.79	0.02	0.03	0.00
232	20.39	233	20.07	401	0.0008	12	9.96	0.000330	9.30	24.39	15.09	Part F	2	1.2	4.00	4.80	5.16	9.96	0.79	0.02	0.03	0.00
233	20.07	239	18.09	164	0.0121	12	9.96	0.000135	9.30	24.07	14.77	Part F	2	1.2	4.00	4.80	5.16	9.96	0.79	0.02	0.03	0.00
239	18.09	240	7.6	50	0.2098	8	9.96	0.000296	9.30	22.09	12.79	Part F	2	1.2	4.00	4.80	5.16	9.96	0.35	0.02	0.06	0.00
240	7.6	051	7.1	105	0.0048	8	57.26	0.015775	9.30	11.6	2.30	Part F,B	12	5.7	4.00	22.93	34.33	57.26	0.35	0.13	0.37	0.00
051	7.1	050	5.9	295	0.0041	8	57.26	0.044320	9.28	11.1	1.82	Part F,B	12	5.7	4.00	22.93	34.33	57.26	0.35	0.13	0.37	0.00
050	5.9	241	5.29	90	0.0068	8	57.26	0.013521	9.23	9.9	0.67	Part F,B	12	5.7	4.00	22.93	34.33	57.26	0.35	0.13	0.37	0.00
241	5.29	090	4.7	200	0.0030	8	241.48	0.430613	9.16	9.29	0.13	B,F	55	20.3	4.00	81.07	160.42	241.48	0.35	0.54	1.54	0.06
090	4.7	091	4.3	100	0.0040	8	241.48	0.215307	8.68	8.7	0.02	B,F	55	20.3	4.00	81.07	160.42	241.48	0.35	0.54	1.54	0.06
091	4.3	105	3.2	275	0.0040	8	387.58	1.420772	8.32	8.3	-0.02	B,D,E,F	89	32.0	4.00	128.00	259.58	387.58	0.35	0.86	2.47	0.14
105	3.2	104	2.2	260	0.0038	8	387.58	1.343275	6.75	7.2	0.45	B,D,E,F	89	32.0	4.00	128.00	259.58	387.58	0.35	0.86	2.47	0.14
104	2.2	140	0.8	345	0.0041	8	425.03	2.114062	5.24	6.2	0.96	B,C,D,E,F	98	34.8	4.00	139.20	285.83	425.03	0.35	0.95	2.71	0.17
140	0.8	106	0	165	0.0048	8	425.03	1.011073	2.95	4.8	1.85	B,C,D,E,F	98	34.8	4.00	139.20	285.83	425.03	0.35	0.95	2.71	0.17
106	0	143	-1.1	170	0.0065	8	425.03	1.041712	1.77	4	2.23	B,C,D,E,F	98	34.8	4.00	139.20	285.83	425.03	0.35	0.95	2.71	0.17
143	-1.1	144	-2.6	190	0.0079	8	511.86	1.642084	0.48	2.9	2.42	A,B,C,D,E,F	118	42.1	3.98	167.69	344.17	511.86	0.35	1.14	3.27	0.25
144	-2.6	111	-3.83	280	0.0044	8	511.86	2.419913	-1.41	1.4	2.81	A,B,C,D,E,F	118	42.1	3.98	167.69	344.17	511.86	0.35	1.14	3.27	0.25

Lk. Line El.   -3.83

K ent/ext= 1.5

Assumptions:
1. Maximum Hgl is assumed to be 4 feet above the manhole inverts

Note: NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Existing Condition: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection
City of Lake Forest Park Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	1.28	3.00	4	1.35	5.18	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	1.28	3.00	4	1.35	5.18	448	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	1.28	3.00	4	1.35	5.18	1756	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	1.28	3.00	4	1.35	5.18	2484	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	6.09	3.00	18	8.99	27.27	348	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	6.09	3.00	18	8.99	27.27	319	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	6.09	3.00	18	8.99	27.27	420	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F,G	104	47.03	3.00	141	79.44	220.54	75	OK
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F,G	104	47.03	3.00	141	79.44	220.54	123	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F,G	138	59.50	3.00	179	105.42	283.92	60	OK
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F,G	138	59.50	3.00	179	105.42	283.92	53	OK
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F,G	147	62.48	3.00	187	112.29	299.72	47	OK
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F,G	147	62.48	3.00	187	112.29	299.72	79	OK
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F,G	147	62.48	3.00	187	112.29	299.72	137	OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F,G	167	70.27	3.00	211	127.57	338.37	145	OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F,G	167	70.27	3.00	211	127.57	338.37	22	OK
Total				3213														

Existing Condition: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection
City of Lake Forest Park Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	Part I	14	2.41	3.00	7	10.69	17.92	403	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	Part I	14	2.41	3.00	7	10.69	17.92	416	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	Part I	14	2.41	3.00	7	10.69	17.92	1628	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	Part I	14	2.41	3.00	7	10.69	17.92	408	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	Part I	14	2.41	3.00	7	10.69	17.92	1808	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	Part I	14	2.41	3.00	7	10.69	17.92	389	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	I, J	87	34.71	3.00	104	66.46	170.58	783	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	I, J	87	34.71	3.00	104	66.46	170.58	2584	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	I, J	87	34.71	3.00	104	66.46	170.58	1936	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	I, J, H	103	41.51	3.00	125	78.68	203.21	2697	OK
Tee118	20.3	236	19.9	170	0.0024	12	0.79	1.732	777	I, J, H	103	41.51	3.00	125	78.68	203.21	574	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	I, J, H	103	41.51	3.00	125	78.68	203.21	565	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	I, J, H	103	41.51	3.00	125	78.68	203.21	1292	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	I, J, H	103	41.51	3.00	125	78.68	203.21	4948	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	I, J, H	103	41.51	3.00	125	78.68	203.21	3412	OK

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #4: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection. Includes Connection Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are Included.
City of Lake Forest Park Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data								Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference		Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm		
016	165.5	**024**	152.0	250	0.0540	8	0.35	2.814	1263	G	49	25.5	3.00	77	37.43	113.93	1149		OK
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	G, Part I	63	27.91	3.00	84	48.13	131.85	289		OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	G, Part I	63	27.91	3.00	84	48.13	131.85	302		OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	G, Part I	63	27.91	3.00	84	48.13	131.85	1514		OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	G, Part I	63	27.91	3.00	84	48.13	131.85	295		OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	G, Part I	63	27.91	3.00	84	48.13	131.85	1694		OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	G, Part I	63	27.91	3.00	84	48.13	131.85	275		OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	G, I, J	136	60.21	3.00	181	103.89	284.51	669		OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	G, I, J	136	60.21	3.00	181	103.89	284.51	2470		OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	G, I, J	136	60.21	3.00	181	103.89	284.51	1823		OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	G, I, J, H	152	67.01	3.00	201	116.11	317.14	2583		OK
Tee118	*20.3*	236	19.9	170	0.0024	12	0.79	1.732	777	G, I, J, H	152	67.01	3.00	201	116.11	317.14	460		OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	G, I, J, H	152	67.01	3.00	201	116.11	317.14	452		OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	G, I, J, H	152	67.01	3.00	201	116.11	317.14	1178		OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	G, I, J, H	152	67.01	3.00	201	116.11	317.14	4834		OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	G, I, J, H	152	67.01	3.00	201	116.11	317.14	3298		OK
Total				2125															

Proposed Alternative #4: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection, Includes Crossing Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are removed
City of Lake Forest Park Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data								Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference		Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm		
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	1.28	3.00	4	1.35	5.18	NS		NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	1.28	3.00	4	1.35	5.18	448		OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	1.28	3.00	4	1.35	5.18	1756		OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	1.28	3.00	4	1.35	5.18	2484		OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	6.09	3.00	18	8.99	27.27	348		OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	6.09	3.00	18	8.99	27.27	319		OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	6.09	3.00	18	8.99	27.27	420		OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F	55	21.53	3.00	65	42.01	106.61	189		OK
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F	55	21.53	3.00	65	42.01	106.61	237		OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F	89	34.00	3.00	102	67.99	169.99	174		OK
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F	89	34.00	3.00	102	67.99	169.99	167		OK
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F	98	36.98	3.00	111	74.86	185.79	160		OK
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F	98	36.98	3.00	111	74.86	185.79	193		OK
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F	98	36.98	3.00	111	74.86	185.79	251		OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F	118	44.77	3.00	134	90.14	224.44	258		OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F	118	44.77	3.00	134	90.14	224.44	136		OK
Total				3213															

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #2: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection. Upgrade Existing 8-inch Sewer with 12-inch Sewer Along Lake Shore Blvd. @ NE 165th St. to Lake Line Conne
City of Lake Forest Park Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	1.28	3.00	4	3.56	7.39	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	1.28	3.00	4	3.56	7.39	445	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	1.28	3.00	4	3.56	7.39	1753	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	1.28	3.00	4	3.56	7.39	2482	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	6.09	3.00	18	23.70	41.98	333	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	6.09	3.00	18	23.70	41.98	305	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	6.09	3.00	18	23.70	41.98	405	OK
241	5.29	090	4.7	200	0.0030	12	0.79	1.939	870	B,F,G	104	47.03	3.00	141	209.44	350.54	520	OK
090	4.7	091	4.3	100	0.0040	12	0.79	2.258	1013	B,F,G	104	47.03	3.00	141	209.44	350.54	663	OK
091	4.3	105	3.2	275	0.0040	12	0.79	2.258	1013	B,D,E,F,G	138	59.50	3.00	179	277.92	456.42	557	OK
105	3.2	104	2.2	260	0.0038	12	0.79	2.214	994	B,D,E,F,G	138	59.50	3.00	179	277.92	456.42	537	OK
104	2.2	140	0.8	345	0.0041	12	0.79	2.275	1021	B,C,D,E,F,G	147	62.48	3.00	187	296.04	483.47	537	OK
140	0.8	106	0	165	0.0048	12	0.79	2.486	1116	B,C,D,E,F,G	147	62.48	3.00	187	296.04	483.47	632	OK
106	0	143	-1.1	170	0.0065	12	0.79	2.872	1289	B,C,D,E,F,G	147	62.48	3.00	187	296.04	483.47	806	OK
143	-1.1	144	-2.6	190	0.0079	12	0.79	3.173	1424	A,B,C,D,E,F,G	167	70.27	3.00	211	336.32	547.12	877	OK
144	-2.6	111	-3.83	280	0.0044	12	0.79	2.367	1062	A,B,C,D,E,F,G	167	70.27	3.00	211	336.32	547.12	515	OK

Total   3213

Proposed Alternative #1: Remove Crossings and Re-Dig Sewer Along the Burke Gilman Trail from NE 165th St. and Lake Shore Blvd to NE 160th Street.
City of Lake Forest Park Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
218	20.06	**095**	17.8	1175	0.0019	12	0.79	1.573	706	F, G	94	42	3.00	127	71.81	198.46	507	OK
095	17.8	**237**	17.1	350	0.0019	12	0.79	1.574	706	F, G, I, J	181	76.93	3.00	231	138.26	369.04	337	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	F, G, I, J, H	197	83.73	3.00	251	150.49	401.66	1094	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	F, G, I, J, H	197	83.73	3.00	251	150.49	401.66	4750	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	F, G, I, J, H	197	83.73	3.00	251	150.49	401.66	3213	OK

1805

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

<u>**Existing Condition:**</u> From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection
Shoreline Wastewater Management District Flow Criteria #1
Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.97	4.00	4	1.35	5.21	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.97	4.00	4	1.35	5.21	447	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.97	4.00	4	1.35	5.21	1756	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.97	4.00	4	1.35	5.21	2484	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	6.42	4.00	26	8.99	34.67	340	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	6.42	4.00	26	8.99	34.67	312	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	6.42	4.00	26	8.99	34.67	413	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F,G	104	56.72	4.00	227	79.44	306.09	-11	Over Capacity
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F,G	104	56.72	4.00	227	79.44	306.09	38	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F,G	138	75.27	3.96	298	105.42	403.31	-60	Over Capacity
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F,G	138	75.27	3.96	298	105.42	403.31	-66	Over Capacity
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F,G	147	80.18	3.95	317	112.29	428.81	-83	Over Capacity
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F,G	147	80.18	3.95	317	112.29	428.81	-50	Over Capacity
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F,G	147	80.18	3.95	317	112.29	428.81	8	OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F,G	167	66.13	3.93	260	127.57	387.18	96	OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F,G	167	66.13	3.93	260	127.57	387.18	-27	Over Capacity
Total				3213														

<u>**Existing Condition:**</u> From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection
Shoreline Wastewater Management District Flow Criteria #1
Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	Part I	14	7.64	4.00	31	28.19	58.74	362	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	Part I	14	7.64	4.00	31	28.19	58.74	375	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	Part I	14	7.64	4.00	31	28.19	58.74	1587	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	Part I	14	7.64	4.00	31	28.19	58.74	368	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	Part I	14	7.64	4.00	31	28.19	58.74	1767	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	Part I	14	7.64	4.00	31	28.19	58.74	348	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	I, J	87	47.45	4.00	190	175.21	365.01	588	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	I, J	87	47.45	4.00	190	175.21	365.01	2390	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	I, J	87	47.45	4.00	190	175.21	365.01	1742	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	I, J, H	103	56.18	4.00	225	207.43	431.95	2468	OK
Tee118	20.3	236	19.9	170	0.0024	12	0.79	1.732	777	I, J, H	103	56.18	4.00	225	207.43	431.95	345	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	I, J, H	103	56.18	4.00	225	207.43	431.95	337	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	I, J, H	103	56.18	4.00	225	207.43	431.95	1064	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	I, J, H	103	56.18	4.00	225	207.43	431.95	4719	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	I, J, H	103	56.18	4.00	225	207.43	431.95	3183	OK
Total				1875														

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative#4: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection. Includes Connection Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are Included.
Shoreline Wastewater Management District Flow Criteria #1
Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
016	165.5	**024**	152.0	250	0.0540	8	0.35	2.814	1263	G	49	26.73	4.00	107	37.43	144.33	1119	OK
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	G, Part I	63	34.36	4.00	137	48.13	185.57	235	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	G, Part I	63	34.36	4.00	137	48.13	185.57	248	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	G, Part I	63	34.36	4.00	137	48.13	185.57	1460	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	G, Part I	63	34.36	4.00	137	48.13	185.57	241	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	G, Part I	63	34.36	4.00	137	48.13	185.57	1640	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	G, Part I	63	34.36	4.00	137	48.13	185.57	221	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	G, I, J	136	74.18	3.96	294	103.89	397.63	556	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	G, I, J	136	74.18	3.96	294	103.89	397.63	2357	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	G, I, J	136	74.18	3.96	294	103.89	397.63	1709	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	G, I, J, H	152	82.90	3.94	327	116.11	442.93	2457	OK
Tee118	*20.3*	236	19.9	170	0.0024	12	0.79	1.732	777	G, I, J, H	152	82.90	3.94	327	116.11	442.93	334	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	G, I, J, H	152	82.90	3.94	327	116.11	442.93	326	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	G, I, J, H	152	82.90	3.94	327	116.11	442.93	1053	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	G, I, J, H	152	82.90	3.94	327	116.11	442.93	4708	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	G, I, J, H	152	82.90	3.94	327	116.11	442.93	3172	OK
Total				2125														

Proposed Alternative #4: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection, Includes Crossing Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are removed
Shoreline Wastewater Management District Flow Criteria #1
Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.97	4.00	4	1.35	5.21	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.97	4.00	4	1.35	5.21	447	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.97	4.00	4	1.35	5.21	1756	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.97	4.00	4	1.35	5.21	2484	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	6.42	4.00	26	42.01	67.69	307	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	6.42	4.00	26	42.01	67.69	279	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	6.42	4.00	26	42.01	67.69	380	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F	55	30.00	4.00	120	42.01	162.01	133	OK
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F	55	30.00	4.00	120	42.01	162.01	182	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F	89	48.54	4.00	194	67.99	262.15	82	OK
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F	89	48.54	4.00	194	67.99	262.15	75	OK
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F	98	53.45	4.00	214	74.86	288.66	58	OK
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F	98	53.45	4.00	214	74.86	288.66	90	OK
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F	98	53.45	4.00	214	74.86	288.66	149	OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F	118	64.36	3.98	256	90.14	346.29	137	OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F	118	64.36	3.98	256	90.14	346.29	14	OK
Total				3213														

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #2: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection. Upgrade Existing 8-inch Sewer with 12-inch Sewer Along Lake Shore Blvd. @ NE 165th St. to Lake Line Conne
Shoreline Wastewater Management District Flow Criteria #1

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.97	4.00	4	1.35	5.21	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.97	4.00	4	1.35	5.21	447	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.97	4.00	4	1.35	5.21	1756	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.97	4.00	4	1.35	5.21	2484	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	6.42	4.00	26	8.99	34.67	340	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	6.42	4.00	26	8.99	34.67	312	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	6.42	4.00	26	8.99	34.67	413	OK
241	5.29	090	4.7	200	0.0030	12	0.79	1.939	870	B,F,G	104	56.72	4.00	227	79.44	306.09	564	OK
090	4.7	091	4.3	100	0.0040	12	0.79	2.258	1013	B,F,G	104	56.72	4.00	227	79.44	306.09	707	OK
091	4.3	105	3.2	275	0.0040	12	0.79	2.258	1013	B,D,E,F,G	138	75.27	3.96	298	105.42	403.31	610	OK
105	3.2	104	2.2	260	0.0038	12	0.79	2.214	994	B,D,E,F,G	138	75.27	3.96	298	105.42	403.31	591	OK
104	2.2	140	0.8	345	0.0041	12	0.79	2.275	1021	B,C,D,E,F,G	147	80.18	3.95	317	112.29	428.81	592	OK
140	0.8	106	0	165	0.0048	12	0.79	2.486	1116	B,C,D,E,F,G	147	80.18	3.95	317	112.29	428.81	687	OK
106	0	143	-1.1	170	0.0065	12	0.79	2.872	1289	B,C,D,E,F,G	147	80.18	3.95	317	112.29	428.81	860	OK
143	-1.1	144	-2.6	190	0.0079	12	0.79	3.173	1424	A,B,C,D,E,F,G	167	91.08	3.93	358	127.57	485.13	939	OK
144	-2.6	111	-3.83	280	0.0044	12	0.79	2.367	1062	A,B,C,D,E,F,G	167	91.08	3.93	358	127.57	485.13	577	OK
Total				3213														

Proposed Alternative #1: Remove Crossings and Re-Dig Sewer Along the Burke Gilman Trail from NE 165th St. and Lake Shore Blvd to NE 160th Street.
Shoreline Wastewater Management District Flow Criteria #1

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
218	20.06	**095**	17.8	1175	0.0019	12	0.79	1.573	706	F, G	94	51	4.00	205	71.81	276.88	429	OK
095	17.8	**237**	17.1	350	0.0019	12	0.79	1.574	706	F, G, I, J	181	98.72	3.91	386	138.26	524.26	182	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	F, G, I, J, H	197	107.45	3.89	418	150.49	568.69	927	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	F, G, I, J, H	197	107.45	3.89	418	150.49	568.69	4583	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	F, G, I, J, H	197	107.45	3.89	418	150.49	568.69	3046	OK
				1805														

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Existing Condition: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection
Shoreline Wastewater Management District Flow Criteria #2
    Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

\<Manhole Data\> Upper	Elevation feet	Lower	Elevation feet	\<Pipe Data\> Length feet	Slope	Diameter inches	Area s.f.	Capacity cfs	Capacity gpm	\<Basin Flow Data\> Upstream Basins	Upstream Acreage	Base Sanitary Flow (gpm)	Peaking Factor	Peak Sanitary Flow (gpm)	I & I gpm	Total Peak Flow (gpm)	\<Capacity\> Capacity Difference gpm	Status
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.68	4.00	3	3.07	5.80	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.68	4.00	3	3.07	5.80	447	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.68	4.00	3	3.07	5.80	1755	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.68	4.00	3	3.07	5.80	2484	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	4.53	4.00	18	20.43	38.56	337	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	4.53	4.00	18	20.43	38.56	308	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	4.53	4.00	18	20.43	38.56	409	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F,G	104	40.04	4.00	160	180.56	340.54	-45	Over Capacity
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F,G	104	40.04	4.00	160	180.56	340.54	3	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F,G	138	53.13	3.96	210	239.58	449.86	-106	Over Capacity
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F,G	138	53.13	3.96	210	239.58	449.86	-113	Over Capacity
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F,G	147	56.60	3.95	223	255.21	478.63	-132	Over Capacity
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F,G	147	56.60	3.95	223	255.21	478.63	-100	Over Capacity
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F,G	147	56.60	3.95	223	255.21	478.63	-41	Over Capacity
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F,G	167	64.30	3.93	252	289.93	542.32	-59	Over Capacity
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F,G	167	64.30	3.93	252	289.93	542.32	-182	Over Capacity

Total   3213

Existing Condition: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection
Shoreline Wastewater Management District Flow Criteria #2
    Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

\<Manhole Data\> Upper	Elevation feet	Lower	Elevation feet	\<Pipe Data\> Length feet	Slope	Diameter inches	Area s.f.	Capacity cfs	Capacity gpm	\<Basin Flow Data\> Upstream Basins	Upstream Acreage	Base Sanitary Flow (gpm)	Peaking Factor	Peak Sanitary Flow (gpm)	I & I gpm	Total Peak Flow (gpm)	\<Capacity\> Capacity Difference gpm	Status
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	Part I	14	5.39	4.00	22	24.31	45.87	375	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	Part I	14	5.39	4.00	22	24.31	45.87	388	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	Part I	14	5.39	4.00	22	24.31	45.87	1600	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	Part I	14	5.39	4.00	22	24.31	45.87	381	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	Part I	14	5.39	4.00	22	24.31	45.87	1780	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	Part I	14	5.39	4.00	22	24.31	45.87	361	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	I, J	87	33.50	4.00	134	151.04	285.02	668	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	I, J	87	33.50	4.00	134	151.04	285.02	2470	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	I, J	87	33.50	4.00	134	151.04	285.02	1822	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	I, J, H	103	39.66	4.00	158	178.82	337.31	2563	OK
Tee118	20.3	236	19.9	170	0.0024	12	0.79	1.732	777	I, J, H	103	39.66	4.00	158	178.82	337.31	440	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	I, J, H	103	39.66	4.00	158	178.82	337.31	431	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	I, J, H	103	39.66	4.00	158	178.82	337.31	1158	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	I, J, H	103	39.66	4.00	158	178.82	337.31	4814	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	I, J, H	103	39.66	4.00	158	178.82	337.31	3278	OK

Total   1875

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #4: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection. Includes Connection Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are Included.
Shoreline Wastewater Management District Flow Criteria #2

Manning "n"   0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
016	165.5	**024**	152.0	250	0.0540	8	0.35	2.814	1263	G	49	18.87	4.00	75	85.07	160.53	1102	OK
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	G, Part I	63	24.26	4.00	97	109.38	206.40	215	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	G, Part I	63	24.26	4.00	97	109.38	206.40	227	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	G, Part I	63	24.26	4.00	97	109.38	206.40	1439	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	G, Part I	63	24.26	4.00	97	109.38	206.40	220	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	G, Part I	63	24.26	4.00	97	109.38	206.40	1620	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	G, Part I	63	24.26	4.00	97	109.38	206.40	200	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	G, I, J	136	52.36	3.96	207	236.11	443.46	510	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	G, I, J	136	52.36	3.96	207	236.11	443.46	2312	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	G, I, J	136	52.36	3.96	207	236.11	443.46	1664	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	G, I, J, H	152	58.52	3.94	231	263.89	494.59	2406	OK
Tee118	20.3	236	19.9	170	0.0024	12	0.79	1.732	777	G, I, J, H	152	58.52	3.94	231	263.89	494.59	283	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	G, I, J, H	152	58.52	3.94	231	263.89	494.59	274	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	G, I, J, H	152	58.52	3.94	231	263.89	494.59	1001	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	G, I, J, H	152	58.52	3.94	231	263.89	494.59	4657	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	G, I, J, H	152	58.52	3.94	231	263.89	494.59	3120	OK
Total				2125														

Proposed Alternative #4: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection, Includes Crossing Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are removed
Shoreline Wastewater Management District Flow Criteria #2

Manning "n"   0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.68	4.00	3	3.07	5.80	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.68	4.00	3	3.07	5.80	447	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.68	4.00	3	3.07	5.80	1755	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.68	4.00	3	3.07	5.80	2484	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	4.53	4.00	18	20.43	38.56	337	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	4.53	4.00	18	20.43	38.56	308	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	4.53	4.00	18	20.43	38.56	409	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F	55	21.18	4.00	85	95.49	180.19	115	OK
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F	55	21.18	4.00	85	95.49	180.19	164	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F	89	34.27	4.00	137	154.51	291.57	52	OK
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F	89	34.27	4.00	137	154.51	291.57	46	OK
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F	98	37.73	4.00	151	170.14	321.06	25	OK
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F	98	37.73	4.00	151	170.14	321.06	57	OK
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F	98	37.73	4.00	151	170.14	321.06	116	OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F	118	45.43	3.98	181	204.86	385.67	97	OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F	118	45.43	3.98	181	204.86	385.67	-25	Over Capacity
Total				3213														

NS = Negative Slope

Capacitycalc.all
4/3/01

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #2: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection. Upgrade Existing 8-inch Sewer with 12-inch Sewer Along Lake Shore Blvd. @ NE 165th St. to Lake Line Conne

Shoreline Wastewater Management District Flow Criteria #2

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.68	4.00	3	3.07	5.80	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.68	4.00	3	3.07	5.80	447	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.68	4.00	3	3.07	5.80	1755	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.68	4.00	3	3.07	5.80	2484	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	4.53	4.00	18	6.92	25.05	350	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	4.53	4.00	18	6.92	25.05	322	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	4.53	4.00	18	6.92	25.05	422	OK
241	5.29	090	4.7	200	0.0030	12	0.79	1.939	870	B,F,G	104	40.04	4.00	160	180.56	340.54	530	OK
090	4.7	091	4.3	100	0.0040	12	0.79	2.258	1013	B,F,G	104	40.04	4.00	160	180.56	340.54	673	OK
091	4.3	105	3.2	275	0.0040	12	0.79	2.258	1013	B,D,E,F,G	138	53.13	3.96	210	239.58	449.86	564	OK
105	3.2	104	2.2	260	0.0038	12	0.79	2.214	994	B,D,E,F,G	138	53.13	3.96	210	239.58	449.86	544	OK
104	2.2	140	0.8	345	0.0041	12	0.79	2.275	1021	B,C,D,E,F,G	147	56.60	3.95	223	255.21	478.63	542	OK
140	0.8	106	0	165	0.0048	12	0.79	2.486	1116	B,C,D,E,F,G	147	56.60	3.95	223	255.21	478.63	637	OK
106	0	143	-1.1	170	0.0065	12	0.79	2.872	1289	B,C,D,E,F,G	147	56.60	3.95	223	255.21	478.63	810	OK
143	-1.1	144	-2.6	190	0.0079	12	0.79	3.173	1424	A,B,C,D,E,F,G	167	64.30	3.93	252	289.93	542.32	882	OK
144	-2.6	111	-3.83	280	0.0044	12	0.79	2.367	1062	A,B,C,D,E,F,G	167	64.30	3.93	252	289.93	542.32	520	OK
Total				3213														

Proposed Alternative #1: Remove Crossings and Re-Dig Sewer Along the Burke Gilman Trail from NE 165th St. and Lake Shore Blvd to NE 160th Street.

Shoreline Wastewater Management District Flow Criteria #2

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
218	20.06	**095**	17.8	1175	0.0019	12	0.79	1.573	706	F, G	94	36	4.00	145	163.19	307.95	398	OK
095	17.8	**237**	17.1	350	0.0019	12	0.79	1.574	706	F, G, I, J	181	69.69	3.91	272	314.24	586.70	120	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	F, G, I, J, H	197	75.85	3.89	295	342.01	637.22	858	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	F, G, I, J, H	197	75.85	3.89	295	342.01	637.22	4514	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	F, G, I, J, H	197	75.85	3.89	295	342.01	637.22	2978	OK
				1805														

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

<u>**Existing Condition:**</u> From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection
City of Seattle Flow Criteria
Manning "n" [0.013]   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.94	2.80	3	1.48	4.10	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.94	2.80	3	1.48	4.10	449	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.94	2.80	3	1.48	4.10	1757	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.94	2.80	3	1.48	4.10	2485	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	4.48	2.80	13	9.81	22.35	353	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	4.48	2.80	13	9.81	22.35	324	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	4.48	2.80	13	9.81	22.35	425	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F,G	104	34.58	2.80	97	86.67	183.50	112	OK
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F,G	104	34.58	2.80	97	86.67	183.50	160	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F,G	138	43.75	2.80	123	115.00	237.50	106	OK
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F,G	138	43.75	2.80	123	115.00	237.50	100	OK
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F,G	147	45.94	2.80	129	122.50	251.13	95	OK
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F,G	147	45.94	2.80	129	122.50	251.13	127	OK
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F,G	147	45.94	2.80	129	122.50	251.13	186	OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F,G	167	51.67	2.80	145	139.17	283.83	199	OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F,G	167	51.67	2.80	145	139.17	283.83	76	OK

Total   3213

<u>**Existing Condition:**</u> From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection
City of Seattle Flow Criteria
Manning "n" [0.013]   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	Part I	14	1.77	2.80	5	11.67	16.63	404	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	Part I	14	1.77	2.80	5	11.67	16.63	417	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	Part I	14	1.77	2.80	5	11.67	16.63	1629	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	Part I	14	1.77	2.80	5	11.67	16.63	410	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	Part I	14	1.77	2.80	5	11.67	16.63	1809	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	Part I	14	1.77	2.80	5	11.67	16.63	390	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	I, J	87	25.52	2.80	71	72.50	143.96	809	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	I, J	87	25.52	2.80	71	72.50	143.96	2611	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	I, J	87	25.52	2.80	71	72.50	143.96	1963	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	I, J, H	103	30.52	2.80	85	85.83	171.29	2729	OK
Tee118	20.3	236	19.9	170	0.0024	12	0.79	1.732	777	I, J, H	103	30.52	2.80	85	85.83	171.29	606	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	I, J, H	103	30.52	2.80	85	85.83	171.29	597	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	I, J, H	103	30.52	2.80	85	85.83	171.29	1324	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	I, J, H	103	30.52	2.80	85	85.83	171.29	4980	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	I, J, H	103	30.52	2.80	85	85.83	171.29	3444	OK

Total   1875

NS = Negative Slope

Proposed Alternative #4: From NE 162nd Street & 38th Avenue NE Southward to 12-inch Lake Line Connection. Includes Connection Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are Included.
City of Seattle Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
016	165.5	**024**	152.0	250	0.0540	8	0.35	2.814	1263	G	49	18.75	2.80	53	40.83	93.33	1170	OK
024	152.0	026	151.7	50	0.0060	8	0.35	0.938	421	G, Part I	63	20.52	2.80	57	52.50	109.96	311	OK
026	151.7	027	151.0	110	0.0064	8	0.35	0.966	434	G, Part I	63	20.52	2.80	57	52.50	109.96	324	OK
027	151.0	036	140.0	120	0.0917	8	0.35	3.667	1646	G, Part I	63	20.52	2.80	57	52.50	109.96	1536	OK
036	140.0	037	139.6	65	0.0062	8	0.35	0.950	426	G, Part I	63	20.52	2.80	57	52.50	109.96	316	OK
037	139.6	084	108.0	280	0.1129	8	0.35	4.068	1826	G, Part I	63	20.52	2.80	57	52.50	109.96	1716	OK
084	108.0	085	107.3	125	0.0056	8	0.35	0.906	407	G, Part I	63	20.52	2.80	57	52.50	109.96	297	OK
085	107.3	087	105.3	65	0.0308	8	0.35	2.124	953	G, I, J	136	44.27	2.80	124	113.33	237.29	716	OK
087	105.3	088	88.6	65	0.2569	8	0.35	6.139	2755	G, I, J	136	44.27	2.80	124	113.33	237.29	2518	OK
088	88.6	096	36.0	350	0.1503	8	0.35	4.695	2107	G, I, J	136	44.27	2.80	124	113.33	237.29	1870	OK
096	36.0	Tee118	20.3	55	0.2847	8	0.35	6.462	2900	G, I, J, H	152	49.27	2.80	138	126.67	264.63	2636	OK
Tee118	*20.3*	236	19.9	170	0.0024	12	0.79	1.732	777	G, I, J, H	152	49.27	2.80	138	126.67	264.63	513	OK
236	19.9	237	17.1	140	0.0200	8	0.35	1.713	769	G, I, J, H	152	49.27	2.80	138	126.67	264.63	504	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	G, I, J, H	152	49.27	2.80	138	126.67	264.63	1231	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	G, I, J, H	152	49.27	2.80	138	126.67	264.63	4887	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	G, I, J, H	152	49.27	2.80	138	126.67	264.63	3350	OK
Total				2125														

Proposed Alternative #4: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection, Includes Crossing Installed from Basin G to Basin I Along NE 162nd Street, Basin G Flows are removed
City of Seattle Flow Criteria

Manning "n" 0.013   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data						Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.94	2.80	3	1.48	4.10	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.94	2.80	3	1.48	4.10	449	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.94	2.80	3	1.48	4.10	1757	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.94	2.80	3	1.48	4.10	2485	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	4.48	2.80	13	9.81	22.35	353	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	4.48	2.80	13	9.81	22.35	324	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	4.48	2.80	13	9.81	22.35	425	OK
241	5.29	090	4.7	200	0.0030	8	0.35	0.658	295	B,F	55	15.83	2.80	44	45.83	90.17	205	OK
090	4.7	091	4.3	100	0.0040	8	0.35	0.766	344	B,F	55	15.83	2.80	44	45.83	90.17	254	OK
091	4.3	105	3.2	275	0.0040	8	0.35	0.766	344	B,D,E,F	89	25.00	2.80	70	74.17	144.17	200	OK
105	3.2	104	2.2	260	0.0038	8	0.35	0.751	337	B,D,E,F	89	25.00	2.80	70	74.17	144.17	193	OK
104	2.2	140	0.8	345	0.0041	8	0.35	0.771	346	B,C,D,E,F	98	27.19	2.80	76	81.67	157.79	188	OK
140	0.8	106	0	165	0.0048	8	0.35	0.843	378	B,C,D,E,F	98	27.19	2.80	76	81.67	157.79	221	OK
106	0	143	-1.1	170	0.0065	8	0.35	0.974	437	B,C,D,E,F	98	27.19	2.80	76	81.67	157.79	279	OK
143	-1.1	144	-2.6	190	0.0079	8	0.35	1.076	483	A,B,C,D,E,F	118	32.92	2.80	92	98.33	190.50	292	OK
144	-2.6	111	-3.83	280	0.0044	8	0.35	0.803	360	A,B,C,D,E,F	118	32.92	2.80	92	98.33	190.50	170	OK
Total				3213														

NS = Negative Slope

Sheridan Beach Collection System Analysis
Capacity Calculation Sheet

Proposed Alternative #2: From Burke Gilman Trail @ NE 160th St. R/W Northward to the 8-inch Lake Line Connection. Upgrade Existing 8-inch Sewer with 12-inch Sewer Along Lake Shore Blvd. @ NE 165th St. to Lake Line Conne
City of Seattle Flow Criteria
Manning "n" [0.013]   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
095	20.26	232	20.39	123	-0.0011	12	0.79	NS	NS	Part F	2	0.94	2.80	3	1.48	4.10	NS	NS
232	20.39	233	20.07	401	0.0008	12	0.79	1.009	453	Part F	2	0.94	2.80	3	1.48	4.10	449	OK
233	20.07	239	18.09	164	0.0121	12	0.79	3.923	1761	Part F	2	0.94	2.80	3	1.48	4.10	1757	OK
239	18.09	240	7.6	50	0.2098	8	0.35	5.547	2490	Part F	2	0.94	2.80	3	1.48	4.10	2485	OK
240	7.6	051	7.1	105	0.0048	8	0.35	0.836	375	Part F,B	12	4.48	2.80	13	9.81	22.35	353	OK
051	7.1	050	5.9	295	0.0041	8	0.35	0.772	347	Part F,B	12	4.48	2.80	13	9.81	22.35	324	OK
050	5.9	241	5.29	90	0.0068	8	0.35	0.997	447	Part F,B	12	4.48	2.80	13	9.81	22.35	425	OK
241	5.29	090	4.7	200	0.0030	12	0.79	1.939	870	B,F,G	104	34.58	2.80	97	86.67	183.50	687	OK
090	4.7	091	4.3	100	0.0040	12	0.79	2.258	1013	B,F,G	104	34.58	2.80	97	86.67	183.50	830	OK
091	4.3	105	3.2	275	0.0040	12	0.79	2.258	1013	B,D,E,F,G	138	43.75	2.80	123	115.00	237.50	776	OK
105	3.2	104	2.2	260	0.0038	12	0.79	2.214	994	B,D,E,F,G	138	43.75	2.80	123	115.00	237.50	756	OK
104	2.2	140	0.8	345	0.0041	12	0.79	2.275	1021	B,C,D,E,F,G	147	45.94	2.80	129	122.50	251.13	770	OK
140	0.8	106	0	165	0.0048	12	0.79	2.486	1116	B,C,D,E,F,G	147	45.94	2.80	129	122.50	251.13	865	OK
106	0	143	-1.1	170	0.0065	12	0.79	2.872	1289	B,C,D,E,F,G	147	45.94	2.80	129	122.50	251.13	1038	OK
143	-1.1	144	-2.6	190	0.0079	12	0.79	3.173	1424	A,B,C,D,E,F,G	167	51.67	2.80	145	139.17	283.83	1140	OK
144	-2.6	111	-3.83	280	0.0044	12	0.79	2.367	1062	A,B,C,D,E,F,G	167	51.67	2.80	145	139.17	283.83	778	OK
Total				3213														

Proposed Alternative #1: Remove Crossings and Re-Dig Sewer Along the Burke Gilman Trail from NE 165th St. and Lake Shore Blvd to NE 160th Street.
City of Seattle Flow Criteria
Manning "n" [0.013]   Assumes Free Discharge into Kenmore Lake Line

Manhole Data				Pipe Data							Basin Flow Data							Capacity	
Upper	Elevation	Lower	Elevation	Length	Slope	Diameter	Area	Capacity	Capacity	Upstream	Upstream	Base Sanitary	Peaking	Peak Sanitary	I & I	Total Peak Flow	Capacity Difference	Status
	feet		feet	feet		inches	s.f.	cfs	gpm	Basins	Acreage	Flow (gpm)	Factor	Flow (gpm)	gpm	(gpm)	gpm	
218	20.06	**095**	17.8	1175	0.0019	12	0.79	1.573	706	F, G	94	36	2.80	101	163.19	264.53	441	OK
095	17.8	**237**	17.1	350	0.0019	12	0.79	1.574	706	F, G, I, J	181	69.69	2.80	195	314.24	509.35	197	OK
237	17.1	091	11.8	70	0.0757	8	0.35	3.332	1496	F, G, I, J, H	197	75.85	2.80	212	342.01	554.38	941	OK
091	8.1	101	5.0	30	0.1033	12	0.79	11.478	5151	F, G, I, J, H	197	75.85	2.80	212	342.01	554.38	4597	OK
101	5.0	102	-4.2	180	0.0509	12	0.79	8.055	3615	F, G, I, J, H	197	75.85	2.80	212	342.01	554.38	3061	OK

NS = Negative Slope

APPENDIX C
PLANNING LEVEL COST ESTIMATES

King County Conveyance System Improvements Project
Sheridan Beach Reliability Project

Planning Level Cost Estimate
Alternative #1:
Remove Crossings and Re-Dig Sewer Along the Burke Gilman Trail from
NE 165th St. and Lake Shore Blvd to NE 160th Street.

Item No.	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$ 2,000.00	$ 2,000.00
2	Traffic Control	DY	15	$ 300.00	$ 4,500.00
3	Temporary Erosion/Sed. Control	LS	1	$ 4,000.00	$ 4,000.00
4	Dewatering/Handling/Disposal	LS	1	$ 5,000.00	$ 5,000.00
5	Saw Cut Pavement	LF	60	$ 2.00	$ 120.00
6	Pavement Removal	SY	44	$ 3.00	$ 133.33
7	Pavement Disposal	SY	44	$ 5.00	$ 222.22
8	Excavation	CY	2,259	$ 2.88	$ 6,506.67
9	Trench Protection	LS	1	$ 7,000.00	$ 7,000.00
10	Soil Disposal	CY	2,259	$ 9.00	$ 20,333.33
11	Remove/Dispose Exist Pipe & MH's	LF	1,525	$ 7.50	$ 11,437.50
12	12-inch Conc. Sewer w/ Bedding	LF	1,525	$ 15.45	$ 23,561.25
13	Install New Manholes	EA	3	$ 3,000.00	$ 9,000.00
14	Connection to Exist. MH's	EA	2	$ 2,000.00	$ 4,000.00
15	Imported Backfill/Compaction	CY	2,259	$ 7.09	$ 16,018.15
16	Base Course 6-inch Thick	SY	44	$ 5.25	$ 233.33
17	Asphalt Pavement Trench Patch	SY	44	$ 37.00	$ 1,644.44
18	Ditch Restoration	SY	847	$ 5.00	$ 4,236.11
19	Furnish & Install Plug	EA	2	$ 50.00	$ 100.00
20	Maintain Existing Service	DY	15	$ 200.00	$ 3,000.00
	Subtotal				$ 123,046.34
	Contingency (30%)				$ 36,913.90
	Subtotal				$ 159,960.25
	Tax (8%)				$ 12,796.82
	Estimated Construction Cost				**$ 172,757.07**
	Engineering/Administration (30%)				$ 51,827.12
	Estimated Permitting Costs				$ 25,000.00
	Total Estimated Project Cost				**$ 250,000.00**

King County Conveyance System Improvements Project
Sheridan Beach Reliability Project

Planning Level Cost Estimate
Alternative #2:
Upgrade Existing 8-inch Connection to the Lake Line with 12-inch Sewer
Lake Shore Boulevard NE to Lake Line

Item No.	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$ 10,000.00	$ 10,000.00
2	Traffic Control	DY	20	$ 300.00	$ 6,000.00
3	Temporary Erosion/Sed. Control	LS	1	$ 4,000.00	$ 4,000.00
4	Dewatering/Handling/Disposal	LS	1	$ 20,000.00	$ 20,000.00
5	Saw Cut Pavement	LF	60	$ 2.00	$ 120.00
6	Pavement Removal	SY	44	$ 3.00	$ 133.33
7	Pavement Disposal	SY	44	$ 5.00	$ 222.22
8	Excavation	CY	741	$ 6.00	$ 4,444.44
9	Trench Protection	LS	1	$ 14,000.00	$ 14,000.00
10	Soil Disposal	CY	741	$ 9.00	$ 6,666.67
11	Remove/Dispose Exist Pipe & MH's	LF	500	$ 7.50	$ 3,750.00
12	12-inch Conc. Sewer w/ Bedding	LF	500	$ 35.00	$ 17,500.00
13	Install New Manholes	EA	2	$ 5,000.00	$ 10,000.00
14	Install New Manholes on Trail	EA	2	$ 4,000.00	$ 8,000.00
15	Connection to Exist. MH's	EA	1	$ 2,000.00	$ 2,000.00
16	Connection to Lake Line	LS	1	$ 15,000.00	$ 15,000.00
17	Imported Backfill/Compaction	CY	741	$ 14.00	$ 10,370.37
18	Base Course 6-inch Thick	SY	44	$ 5.25	$ 233.33
19	Asphalt Pavement Trench Patch	SY	44	$ 37.00	$ 1,644.44
20	Lawn/Landscape Restoration	SY	278	$ 6.50	$ 1,805.56
21	Maintain Existing Service	DY	20	$ 500.00	$ 10,000.00
	Subtotal				$ 145,890.37
	Contingency (30%)				$ 43,767.11
	Subtotal				$ 189,657.48
	Tax (8%)				$ 15,172.60
	Estimated Construction Cost				**$ 204,830.08**
	Engineering/Administration (30%)				$ 61,449.02
	Estimated Permitting Costs				$ 90,000.00
	Total Estimated Project Cost				**$ 357,000.00**

King County Conveyance System Improvements Project
Sheridan Beach Reliability Project

Planning Level Cost Estimate
Alternative #3:
Install Pump Station and Route Excess Flows to the McAleer Trunk
Install 12-inch Sewer Along Shore Drive from NE 165th Street to Pump Station

Item No.	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$ 10,000.00	$ 10,000.00
2	Traffic Control	DY	20	$ 300.00	$ 6,000.00
3	Temporary Erosion/Sed. Control	LS	1	$ 4,000.00	$ 4,000.00
4	Dewatering/Handling/Disposal	LS	1	$ 5,000.00	$ 5,000.00
5	Saw Cut Pavement	LF	4,140	$ 2.00	$ 8,280.00
6	Pavement Removal	SY	981	$ 3.00	$ 2,943.33
7	Pavement Disposal	SY	981	$ 5.00	$ 4,905.56
8	Excavation, Force Main	CY	509	$ 6.00	$ 3,055.56
9	Excavation, Pump Station	CY	21	$ 6.00	$ 125.66
10	Excavation, Sewer	CY	3,378	$ 2.88	$ 9,728.00
11	Trench Protection	LS	1	$ 3,320.00	$ 3,320.00
12	Soil Disposal	CY	3,908	$ 9.00	$ 35,171.83
13	12-inch Conc. Sewer w/ Bedding	LF	1,520	$ 15.45	$ 23,484.00
14	Install New Manholes	EA	6	$ 3,000.00	$ 18,000.00
15	Connection to Exist. MH's	EA	4	$ 2,000.00	$ 8,000.00
16	6-Inch Ductile Iron Force Main	LF	550	$ 16.00	$ 8,800.00
17	Hang FM from Bridge	LS	1	$ 4,000.00	$ 4,000.00
18	Connection of FM to Exist. MH	EA	1	$ 2,000.00	$ 2,000.00
19	Install Overflow Structure	EA	1	$ 10,000.00	$ 10,000.00
20	Install Packaged Pump Station	LS	1	$ 55,000.00	$ 55,000.00
21	Install Backup Generator	LS	1	$ 35,300.00	$ 35,300.00
22	Imported Backfill/Compaction	CY	3,887	$ 14.00	$ 54,418.52
23	Base Course 6-inch Thick	SY	981	$ 5.25	$ 5,150.83
24	Asphalt Pavement Trench Patch	SY	981	$ 37.00	$ 36,301.11
25	Install New Manholes on Trail	EA	2	$ 4,000.00	$ 8,000.00
26	Maintain Existing Service	DY	20	$ 500.00	$ 10,000.00
	Subtotal				$ 370,984.40
	Contingency (30%)				$ 111,295.32
	Subtotal				$ 482,279.72
	Tax (8%)				$ 38,582.38
	Estimated Construction Cost				**$ 520,862.10**
	Engineering/Administration (30%)				$ 156,258.63
	Estimated Permitting Costs				$ 90,000.00
	Total Estimated Project Cost				**$ 768,000.00**

Note: Cost estimate does not include costs for property/easement acquisitions, if needed.

King County Sheridan Beach Collection System Study

Project:
Install Pumps and Controls in Abandoned Pump Station
Install Force Main and Connection to McAleer Trunk

Description	Qnty	Units	Unit Cost		Total Cost	
Operations Labor [1]	54	HR	$	35	$	1,890
Maintenance Labor	16	HR	$	35	$	560
Equipment and Repairs [2]	1	LS	$	2,500	$	2,500
Electricity [3]	50	KWH	$	0.06	$	3
ESTIMATED O&M COSTS					**$**	**4,953**

Notes:

(1) Based on two (2) one-hour visit per month by a 2 person crew, lus daily bisist during pump station operation 3 times per year.

(2) Based on 5% of the estimated equipment costs.

(3) Based on 3 operating cycles per year wirth 12 hours of pumping in each operating cycle at 200 gpm and 20 ft TDH.

King County Conveyance System Improvements Project
Sheridan Beach Reliability Project

Planning Level Cost Estimate
Alternative #4:
Sewer Installation: NE 162nd Street Between 37th Avenue NE & 38th Avenue NE

Item No.	Description	Unit	Quantity	Unit Price	Total
1	Mobilization	LS	1	$ 2,000.00	$ 2,000.00
2	Traffic Control	DY	5	$ 300.00	$ 1,500.00
3	Temporary Erosion/Sed. Control	LS	1	$ 1,000.00	$ 1,000.00
4	Dewatering/Handling/Disposal	LS	1	$ 5,000.00	$ 5,000.00
5	Saw Cut Pavement	LF	510	$ 2.00	$ 1,020.00
6	Pavement Removal	SY	139	$ 3.00	$ 416.67
7	Pavement Disposal	SY	139	$ 5.00	$ 694.44
8	Excavation	CY	926	$ 2.88	$ 2,666.67
9	Trench Protection	LS	1	$ 10,000.00	$ 10,000.00
10	Soil Disposal	CY	926	$ 9.00	$ 8,333.33
11	8-inch Conc. Sewer w/ Bedding	LF	250	$ 9.25	$ 2,312.50
12	Connection to Exist. MH's	EA	2	$ 2,000.00	$ 4,000.00
13	Install New Manholes on Trail	EA	2	$ 4,000.00	$ 8,000.00
14	Imported Backfill/Compaction	CY	926	$ 7.09	$ 6,564.81
15	Base Course 6-inch Thick	SY	139	$ 5.25	$ 729.17
16	Asphalt Pavement Trench Patch	SY	139	$ 37.00	$ 5,138.89
17	Grind/Overlay Street	SY	1,000	$ 25.00	$ 25,000.00
18	Furnish & Install Plug	EA	1	$ 50.00	$ 50.00
19	Maintain Existing Service	DY	5	$ 200.00	$ 1,000.00
	Subtotal				$ 85,426.48
	Contingency (30%)				$ 25,627.94
	Subtotal				$ 111,054.43
	Tax (8%)				$ 8,884.35
	Estimated Construction Cost				**$ 119,938.78**
	Engineering/Administration (30%)				$ 2,665.31
	Estimated Permitting Costs				$ 5,000.00
	Total Estimated Project Cost				**$ 128,000.00**

APPENDIX D
KING COUNTY TECHNICAL
MEMORANDUM REGARDING
KENMORE LAKE LINE CAPACITY

EXISTING LAKELINE

The existing 48-inch diameter pile-supported, underwater, Kenmore Interceptor Section 2, commonly referred to as the Kenmore Lakeline, conveys flow for approximately five miles along the northwestern shoreline of Lake Washington from the Kenmore Logboom Park Regulator to Matthews Park. The purpose of the Lakeline is to convey King County northern service area flows by gravity from the Logboom Park Regulator to the Matthews Park Pump Station. These flows are then pumped by the Matthews Park Pump Station and conveyed another ten miles through the Lake City Tunnel and the North Interceptor to the West Treatment Plant.

REDUCING LAKELINE SERVICE AREA AND FLOWS

Wastewater from several northern service area basins are collected and conveyed through the Kenmore Lakeline and on to the West Treatment Plant. The County significantly reduced the area served by the Kenmore Lakeline when the York Pump Station began operation in 1992. To further reduce flows to the Lakeline, the County has planned and constructed projects to store peak north service area peak flows. The County has also diverted flow from some of the north service area basins to the Eastside Interceptor (ESI), a pipeline aligned along I-405, east of Lake Washington. The ESI then conveys this flow to the East Treatment Plant in Renton.

Further Lakeline service area reductions resulted from the commissioning of the new North Creek Pump Station in the fall of 1999. The North Creek Pump Station conveys additional wet-weather flows from the north service area to the East Treatment Plant in Renton. As a result of these diversions, the number of basins serviced by the Kenmore Lakeline during high flow events has been reduced in half. Through 2003, summer wastewater flows from the north service area may continue to be routed to the West Treatment Plant to take advantage of capacity in the system during low dry-weather system flows.

In addition to diverting basins (transferring flows) away from the Lakeline, the County has planned and constructed storage projects to reduce peak flows through the Lakeline. Peak flows are experienced just after the most intense rainfall periods during storm events. Lakeline flows are reduced by storing peak period flows for later conveyance through the pipe after peak flows have decreased. These storage and diversion projects are described in Table 1.

Table 1 Facilities To Reduce Peak Flows To The Kenmore Pump Station		
Project	**Year In-service**	**Purpose**
Logboom Storage	1988	Reduce peak flows to Kenmore Lakeline
York Pump Station	1992	Divert Redmond, Northeast Lake Sammamish basins to ESI
North Creek Pump Station	1999	Divert Woodinville, Bear Creek, and North Creek basins (in Snohomish and King Co.) to ESI
North Creek Storage	2002	Reduce peak flows to Kenmore Lakeline

Figure 1 displays the area originally served by the Kenmore Lakeline, the areas that have been diverted away from the existing Lakeline since 1992, and areas that were diverted in 1999.
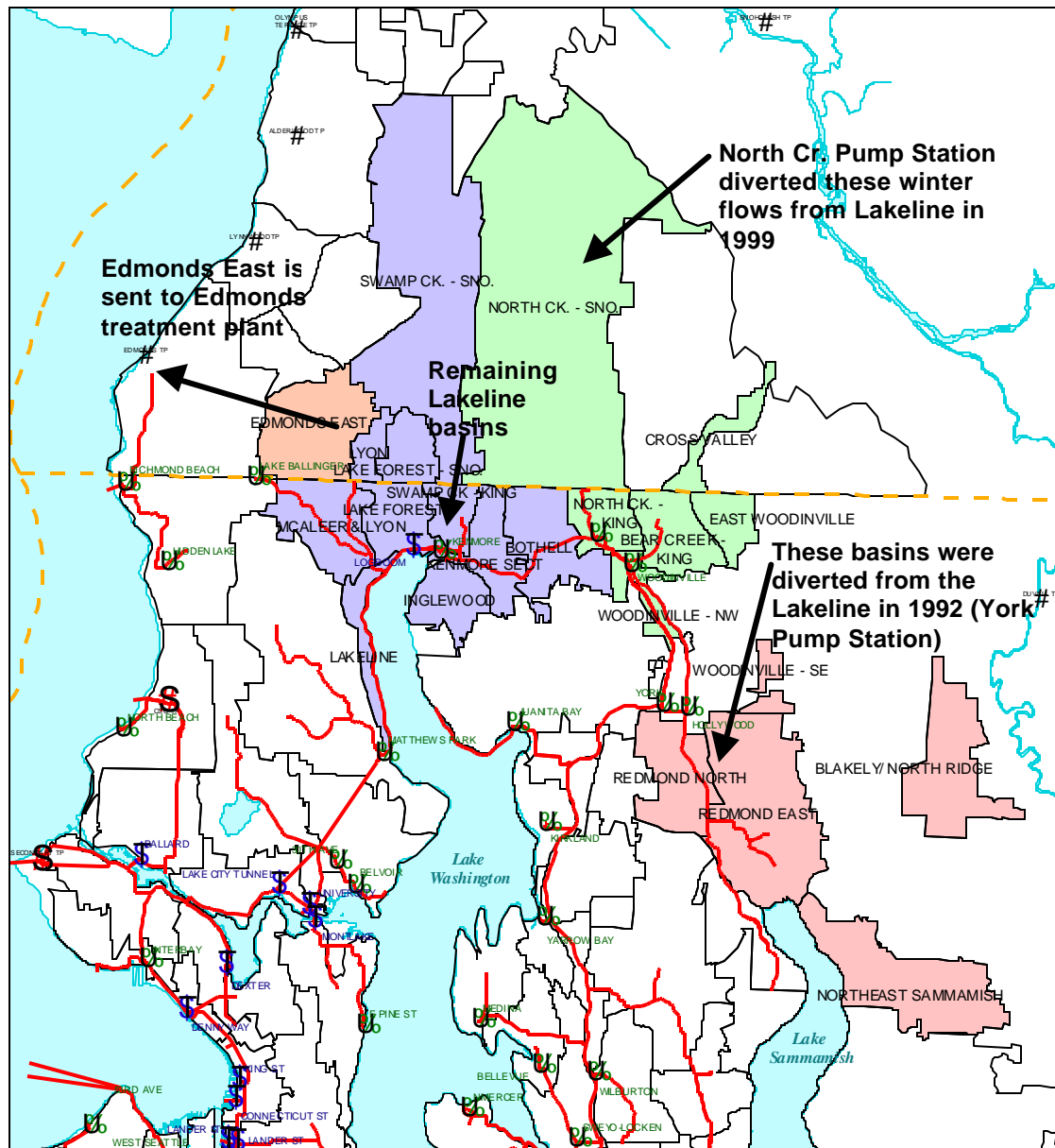
Figure 1. Remaining Lakeline Service Area

The relationship between needed storage and the predicted 20-year peak flow event is depicted in Figure 2. The required storage for a given peak flow event is represented by the area under the hydrograph but above the Lakeline capacity. For example, 9 MG of storage is required in 2010. This storage would be provided by 4 MG of storage in the Logboom Regulator, 2 MG of storage in the Bothell-Woodinville Interceptor, and 6 MG of storage at the North Creek Pump Station site for a total of 12 MG of storage. The 2 MG of storage in the Bothell-Woodinville Interceptor became available in the fall of 1999 when flows were diverted by the North Creek Pump Station to the East Treatment Plant during the winter. The correlation between the required storage capacity and the required storage capacity is summarized in Table 2.
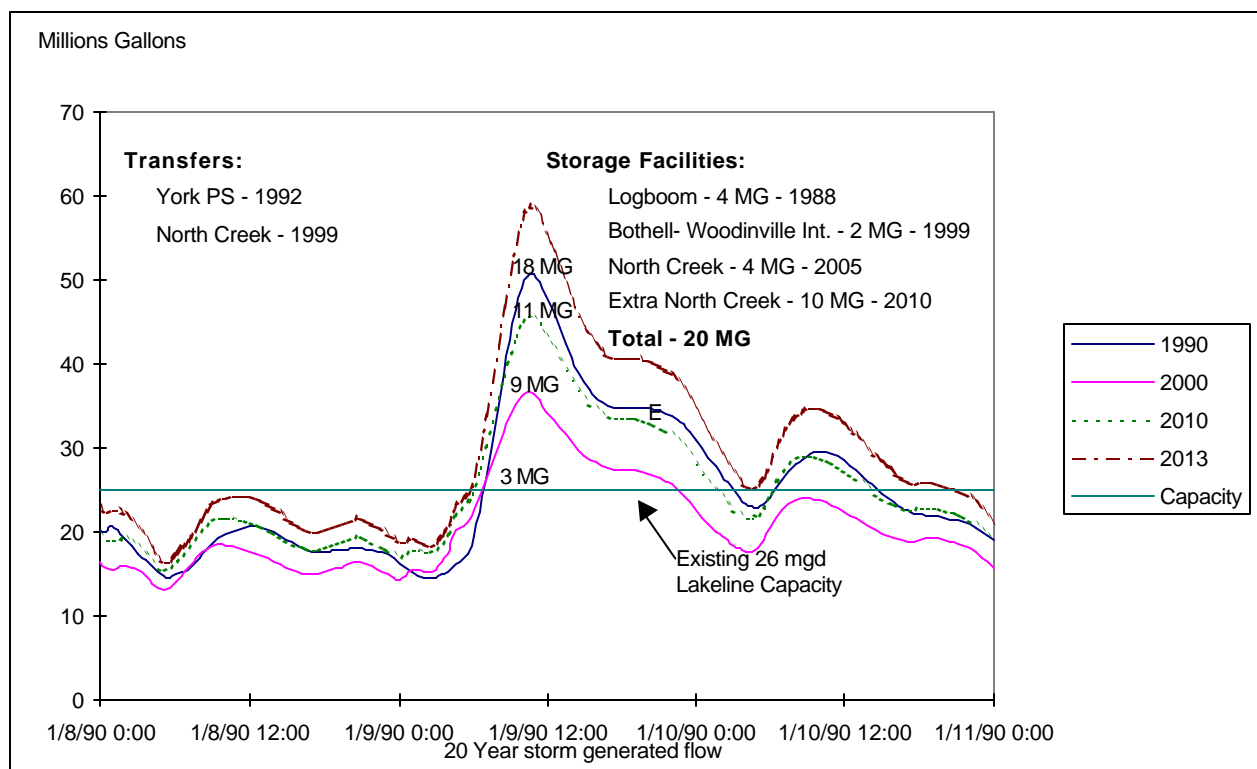
Figure 2. Predicted Kenmore Lakeline 20-year Peak Hydrographs in the Regional Wastewater Services Plan

	Table 2 Construction of North End Storage Facilities		
Year	Storage Facilities	Storage Available (MG)	Storage Required (MG)
2000	Logboom, Bothell-Woodinville Interceptor	6	3
2010	Logboom, Bothell-Woodinville Interceptor, and North Creek[1]	12	9
2015	Logboom, Bothell-Woodinville Interceptor, North Creek, and North Lake Interceptor[2]	20	20
Notes: (1) North Creek storage constructed in 2002. (2) Tunnel Storage constructed by 2006.			

Implementation of these diversion and storage facilities will mean that the existing Lakeline will have adequate capacity until at least 2010 when the North Treatment Plant is scheduled to be in operation. Figure 3 shows the portions of the north end peak flows that could be conveyed through the Lakeline which has a capacity of 26 mgd, diverted, and stored at the Logboom Park Storage Facility and other north-end storage facilities. This strategy could be used to manage flows until 2015 in case of a delay in constructing the North Treatment Plant beyond 2010. These projections include the diversion of up to 6 mgd of peak flow to

the Edmonds Wastewater Treatment Plant starting in 2010 should the North Treatment Plant be delayed until 2015. Once these diversions, storage facilities, and North Treatment Plant are completed, the existing Kenmore Lakeline will serve only the near shore Lake Washington Basin and some of the McAleer/Lyon and Lake Ballinger Basins. After that time, the remaining flow in the Lakeline will be well below the capacity of the Lakeline.
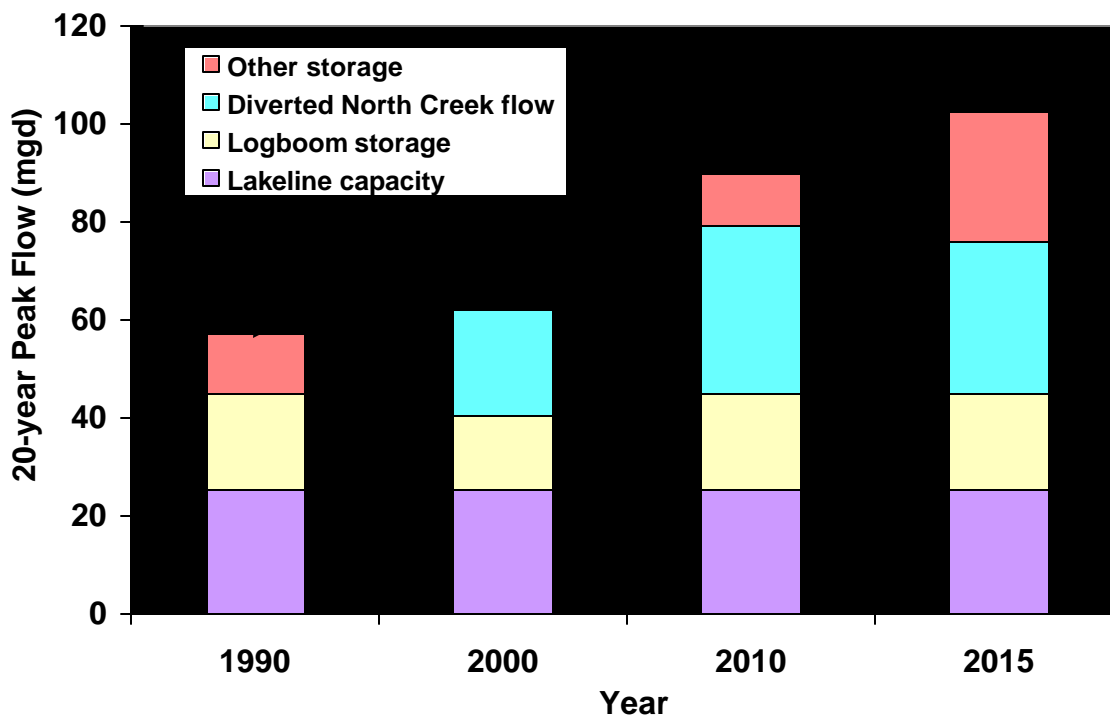
Figure 3. Interim North End Flow Management: 20-Year Peak Flows

APPENDIX E
HDR TECHNICAL MEMORANDUM: IMPROVED SHERIDAN BEACH
RELIABILITY WITH DIVERSION OF LOCAL BASIN G

King County CSI Project
Sheridan Beach Reliability Project
Memorandum

Date: March 27, 2001

To: Bob Peterson (King County)

From: Jim Peterson (HDR); Sam Perry (HDR)

Subject: Improved Sheridan Beach Reliability with Diversion of Local Basin G

King County diverts a number of wastewater service basins from the Kenmore Interceptor Section 2 (Lake Line) during the wet weather months to decrease peak flow volumes to the Lake Line. These diverted basins include the Redmond-North and East, NE Sammamish, North Creek-Snohomish and King Counties, Bear Creek, Woodinville, and Cross Valley Basins (Figure 1). These wastewater diversions and the storage facilities have significantly reduced the potential for the Lake Line to be surcharged during peak flow events. The County is now also designing the North Creek Storage Facility, which is scheduled to be on-line in early 2003, to further reduce peak flows to the Lake Line. These storage facilities and diversions are summarized in Appendix D. The County usually operates the Lake Line without surcharging i.e. without backing flow into manholes or into County lines tributary to the Lake Line. Surcharging occurs only under extreme conditions including severe wet weather storm and/or other catastrophic events.

The purpose of this memo is to analyze local sewer system hydraulics when the Lake Line is full and when surcharged to provide additional understanding of the reduced risk for local system overflows that resulted from diverting local service Basin G. Basin G, which was historically tributary to the 8-inch Lake Line Connection in the vicinity of Sheridan Beach, was diverted to the south in January 2001. This basin is depicted on the Sheridan Beach wastewater service area map provided at the end of this memo.

SHERIDAN BEACH WASTEWATER DRAINAGE

The evaluation outlined in this memorandum is based on flow data provided by KCWTD staff that divided the Sheridan Beach wastewater service area into areas that are tributary to the 8-inch Lake Line Connection (Northerly Basin) and into areas that are tributary to the 12-inch Lake Line Connection (Southerly Basin). These basins are depicted on the attached figure. With the diversion of Basin G, only Basins A, B, C, D, E, and F are tributary to the 8-inch Lake Line Connection and are depicted in a lighter tone than Basins G, H, I, and J which are tributary to the 12-inch Lake Line Connection.

MODELING RESULTS

Iterative runs of the KCWTD model [1] determined that the projected peak 20-year I/I rates are approximately 4,900 gpad (gallons per acre per day) for the Northerly Basin and 5,940 gpad for Southerly Basin. Local system overflows through the manholes will not occur during a 20-year I/I event even if the Lake Line is surcharged up to the minimum winter Lake Washington elevation of 7.02 feet (City of Seattle Datum). However, if the Lake Line were to be surcharged to the historical maximum summer Lake Washington elevation of 9.02 feet (City of Seattle Datum), an overflow would occur under less extreme conditions. The relationships between potential surcharge elevations and I/I rates for the Northerly Basin and Southerly Basin of the Sheridan Beach wastewater service area are summarized in Table 1 and Table 2 respectively. The Corps of Engineers (Corps) summary hydrograph for Lake Washington, which is the basis for the Lake Washington water surface elevations cited in the tables below, is provided at the end of this memo (Figure 2).

Table 1: Northerly Basin Surcharge Elevations and I/I Recurrence Intervals

Maximum Potential Surcharge			Maximum Northerly Basin I/I (gpad)	I/I Recurrence Interval [2] (years)
Criteria	Elevation [1] (Feet COS Datum)	Corps Operation Period		
Crown of Lake Line	-1.30	NA	>>5,140	>> 50
Minimum Winter Lake Washington Elevation	7.02	Dec 1 - Apr 1	4,900	20
Maximum Winter Lake Washington Elevation	7.52	Dec 1 - Feb 1	4,750	11
Mean Spring/Fall Lake Washington Elevation	8.02	See Note 3	4,590	6
Maximum Historic Lake Washington Elevation	9.02	Apr 1 - Oct 1	4,280	1.8
Notes: (1) The elevation of Lake Washington is the maximum elevation to which the Lake Line can be surcharged without causing the flapgates on the Lake Line to open. (2) Generally speaking, a 20-year storm is 3.5 inches of rainfall in 24 hours and a 6-year storm is 2.6 inches of rainfall in 24 hours. (3) This water surface elevation could be reached in Lake Washington as early as mid-February and maintained as late as mid-November.				

Based on the analyses summarized in Table 1, if the Lake Line were to be surcharged to the maximum feasible level at any time other than when the lake is at the winter minimum, a 20-year I/I event could not be conveyed to the Lake Line without an overflow out the top of local manholes. More specifically, to prevent local surface flooding in the Northerly Basin in a 20-year storm with the Lake Line surcharged to 8.02 feet (City of Seattle Datum) the local I/I rate must be at or below 4,590 gpad. The current 20-year calculated local I/I rate for the Northerly Basin is 4,900 gpad. Conversely, given what the regional I/I monitoring program to date has shown, the local system can convey no greater than a 6-year storm without local flooding with the Lake Line surcharged to 8.02 feet (lake level). This is important information for the local sewer agency and the City of Lake Forest Park to use in targeting local I/I reduction efforts.

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[1] The flow data model used by the County was calibrated using the Regional I/I Reduction program's flow monitoring information that was recently published by the Consultant team working on that project.

Table 2: Southerly Basin Surcharge Elevations and I/I Recurrence Intervals

	Maximum Potential Surcharge		Maximum Southerly Basin I/I (gpad)	I/I Recurrence Interval [2] (years)
Criteria	Elevation [1] (Feet COS Datum)	Corps Operation Period		
Crown of Lake Line	-2.92	NA	>6,235	>50
Minimum Winter Lake Washington Elevation	7.02	Dec 1- Apr 1	>6,235	>50
Maximum Winter Lake Washington Elevation	7.52	Dec 1 - Feb 1	>6,235	>50
Mean Spring/Fall Lake Washington Elevation	8.02	See Note 3	>6,235	>50
Maximum Historic Lake Washington Elevation	9.02	Apr 1 - Oct 1	>6,235	>50

Notes:
(1) The elevation of Lake Washington is the maximum elevation to which the Lake Line can be surcharged without causing the flapgates on the Lake Line to open.
(2) Generally speaking, a 20-year storm is 3.5 inches of rainfall in 24 hours and a 6-year storm is 2.6 inches of rainfall in 24 hours.
(3) This water surface elevation could be reached in Lake Washington as early as mid-February and maintained as late as mid-November.

For the Southerly Basin, there appears to be only a minimal risk of local surface flooding, even if the Lake Line were to be surcharged to 9.02 feet (City of Seattle Datum), based on the analyses summarized in Table 2.

ADDITIONAL MODELING SCENARIOS

The following scenarios were evaluated for the 20-year recurrence interval I/I events to further confirm the benefits of diverting Basin G:

1. The Lake Line flowing full and no diversion of Basin G.
2. The Lake Line flowing full with Basin G diverted.
3. The Lake Line surcharged 2 feet and no diversion of Basin G.
4. The Lake Line surcharged 2 feet with Basin G diverted.
5. The Lake Line surcharged to the minimum winter elevation of Lake Washington without diversion of Basin G.
6. The Lake Line surcharged to the minimum winter elevation of Lake Washington with Basin G diverted.

These hydraulic analyses summarized in Table 3 are further validation that the diversion of Basin G significantly relieves the 8-inch Lake Line Connection. The diversion of Basin G decreases the maximum surcharge by more than 12 feet under 20-year recurrence interval I/I events and eliminates surcharging in local sewers when the Lake Line is flowing full, but not surcharged.

Table 3: Hydraulic Analysis of Sheridan Beach Local Sewers[2] with both a full and a surcharged King County Kenmore Interceptor Lake Line[3]

Scenario	King County's Lake Line	Basin G Diverted	Surcharge at Local MH 240[4]	Surcharge at Local MH 237[5]
1	Flowing Full	N	11.8 feet (Overflow)	None – Partial Pipe Flow
2	Flowing Full	Y	None – Partial Pipe Flow	None – Partial Pipe Flow
3	Surcharged 2 feet	N	13.8 feet (Overflow)	None – Partial Pipe Flow
4	Surcharged 2 feet	Y	1.4 feet	None – Partial Pipe Flow
5	Surcharged to Winter Lake Elevation	N	20.1 feet (Overflow)	None – Partial Pipe Flow
6	Surcharged to Winter Lake Elevation	Y	7.7 feet	None – Partial Pipe Flow

SUMMARY

The following conclusions can be drawn from the hydraulic modeling for the Sheridan Beach wastewater service area:

- Diverting Basin G to the 12-inch Lake Line Connection has significantly reduced the risk of surface flooding in the Northerly Basin.
- Diverting Basin G has not significantly increased the risk of surface flooding in the Southerly Basin.
- Local I/I reduction is still required to minimize the risk of surface flooding, especially in the Northerly Basin.

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[2] The water surface elevations at two local system manholes (MH) were evaluated to quantify the potential for local sewer flooding. These two reference local MHs are some of the most vulnerable to local system sewer flooding based on the area topography and local system hydraulics.

[3] The County's Kenmore Lakeline runs full at 26 mgd without surcharging into the local system.

[4] Local sewer MH 240, located in Lakeshore Drive between NE 165th Street and NE 160th Street, was used as the reference point upstream of the 8-inch Lake Line Connection. The MH 240 invert elevation is at 7.6 feet (City of Seattle Datum) and can be surcharged up to an elevation of 16.0 feet (City of Seattle Datum) or a total of 7.7 feet of surcharge above the crown of the pipe without coming out of the top of the MH.

[5] Local sewer MH 237, located near the 12-inch Lake Line Connection and the Burke-Gilman Trail intersection, was used a reference point for the 12-inch Lake Line Connection. The MH 237 invert elevation is at 17.7 feet and can be surcharged up to 7.7 feet without coming out of the top of the MH.
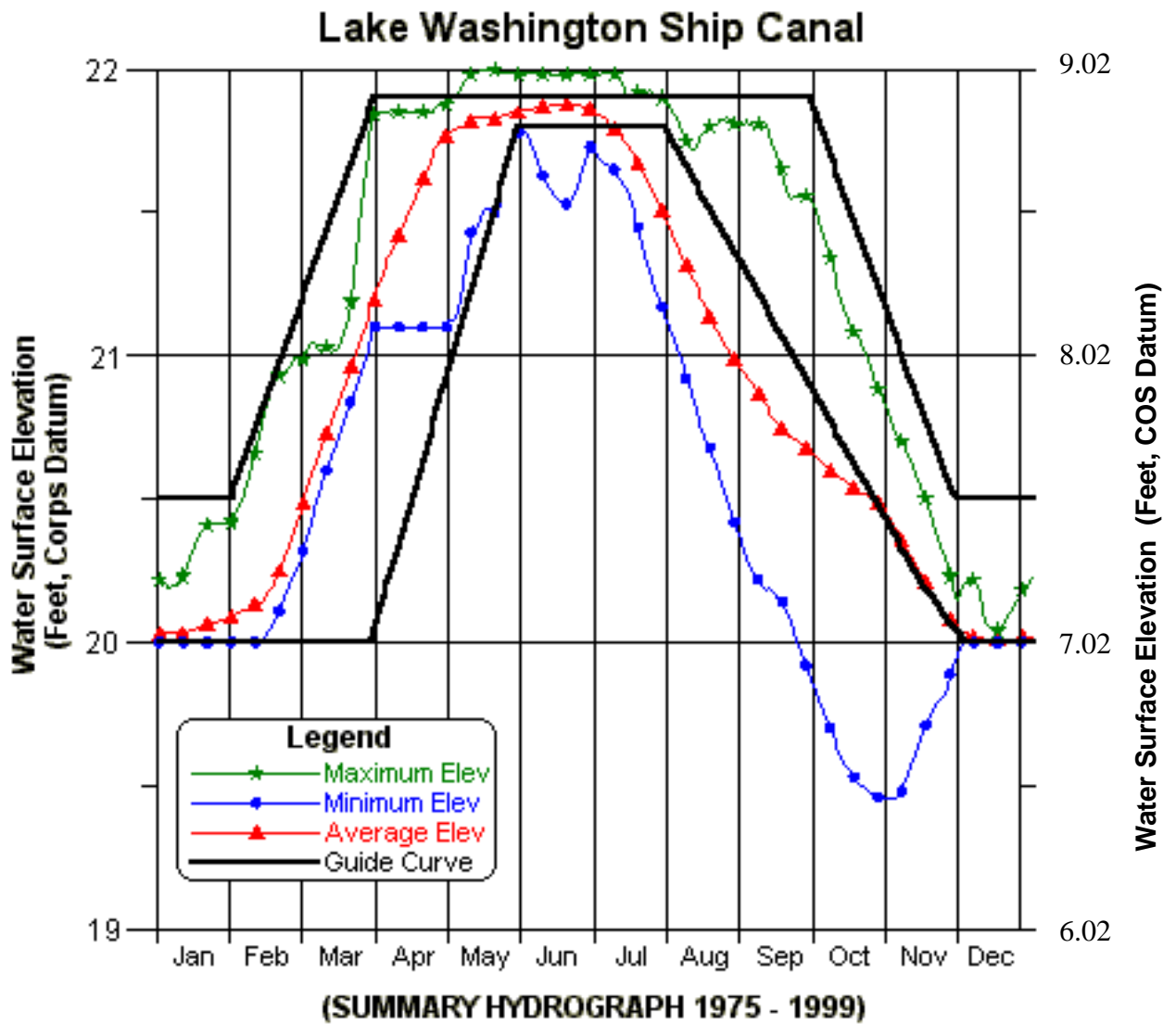
Figure 1. Remaining Lake Line Service Area
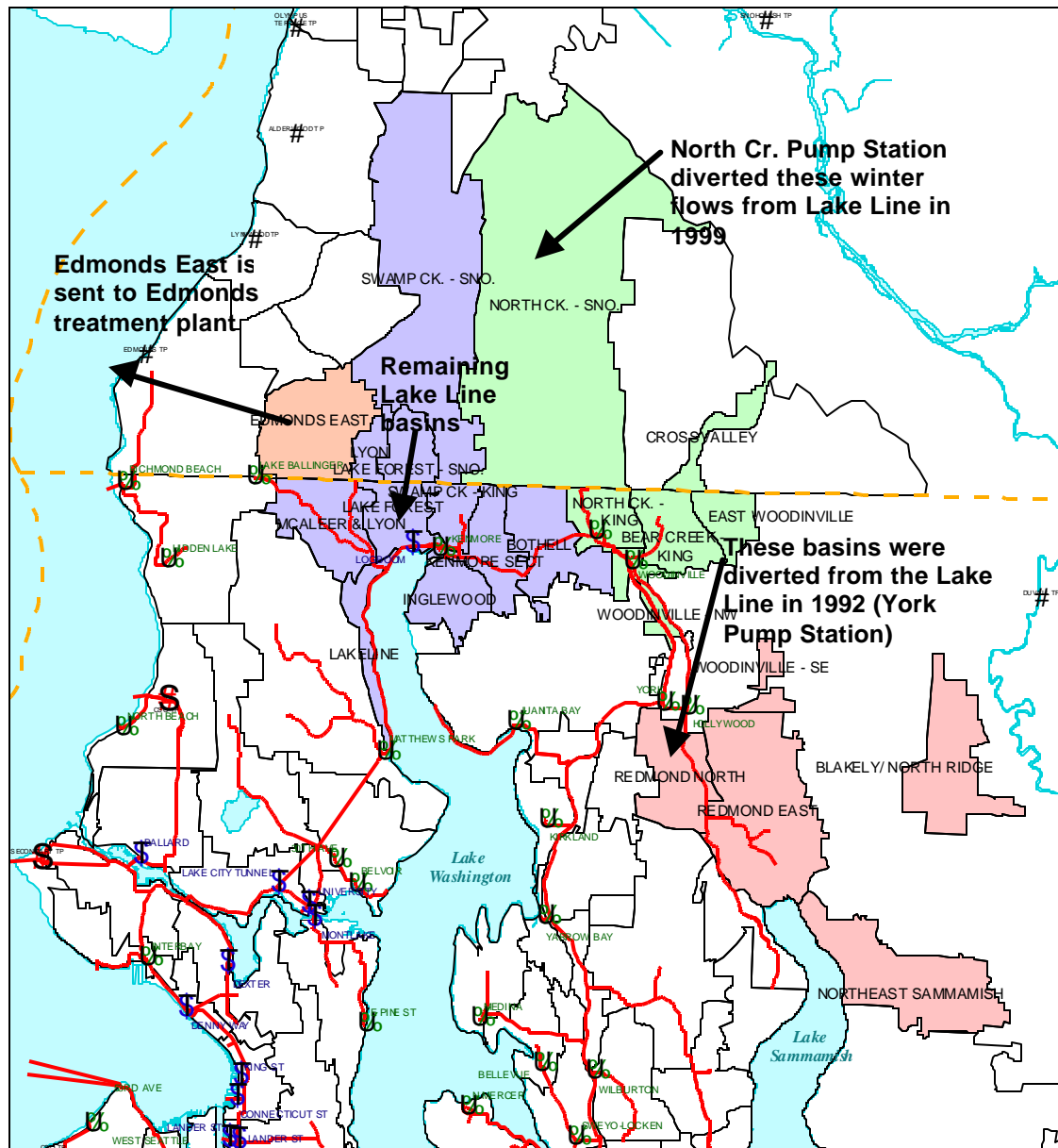
Figure 2. Lake Washington Summary Hydrograph[6]

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[6] To convert from the Corps Datum to the COS Datum, subtract 12.98 feet.